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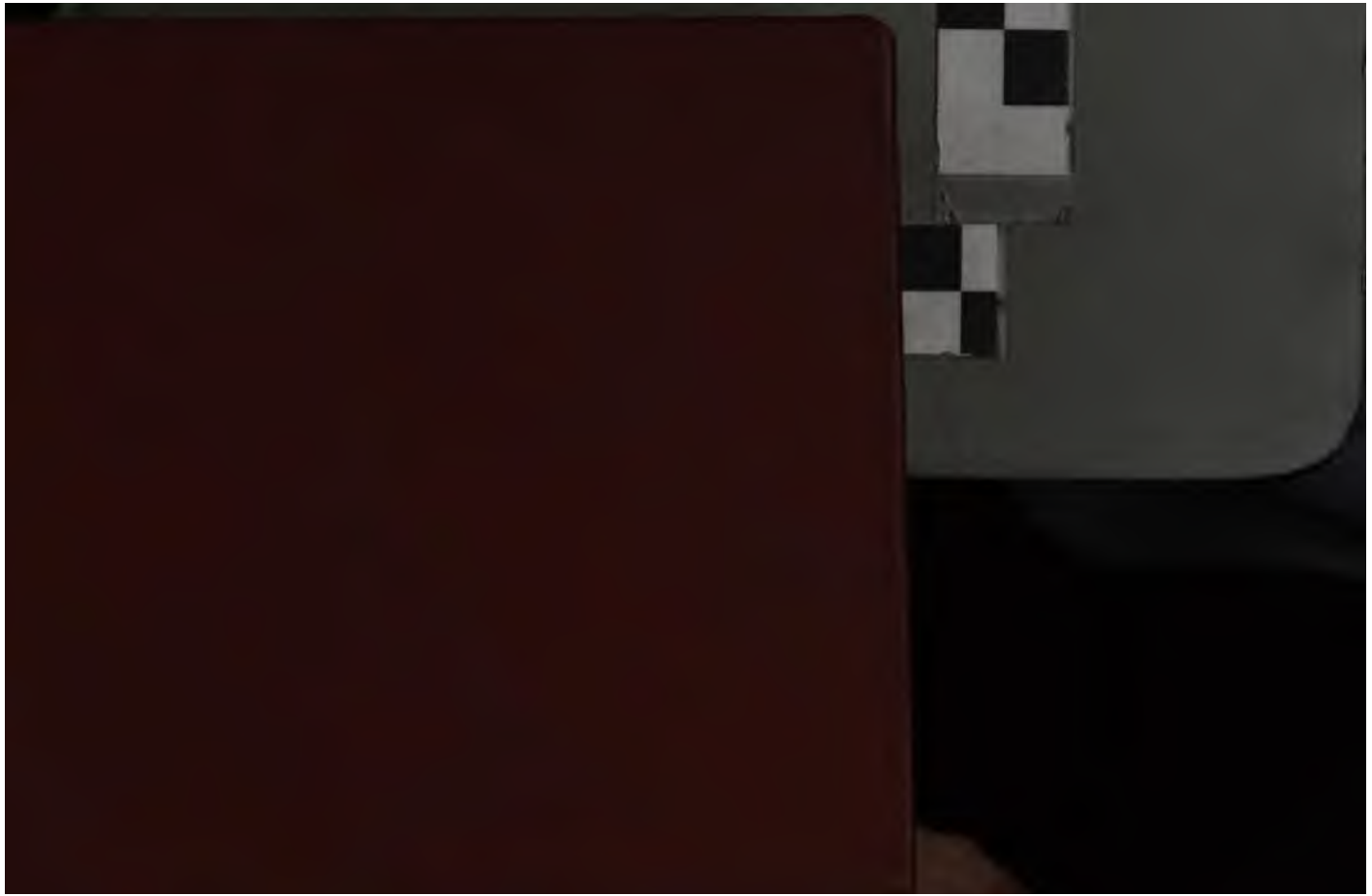

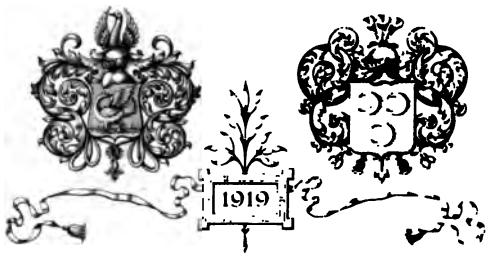

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THE WORKS

OF

FRANCIS BACON.

THE

WORKS

OF

FRANCIS BACON,

BARON OF VERULAM, VISCOUNT ST. ALBANS, AND
LORD HIGH CHANCELLOR OF ENGLAND.

Collected and Edited

BY

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TEMPORIS PARTUS MASCULUS.

PREFACE

TO THE

TEMPORIS PARTUS MASCULUS.

At the end of the manuscript of the *Valerius Terminus*, and immediately following it in the same page, in the hand of the same transcriber, I find the title and the first chapter of the piece which follows; and in the list of contents inserted by Bacon himself at the beginning of the manuscript, I find them thus described: "The first chapter of a book of the same argument, written in Latin, and destined to be separate and not public." The design and commencement of the work may therefore, in default of other evidence, be safely referred to the time when Bacon revised the manuscript of *Valerius Terminus*.

Again, in Gruter's *Scripta Philosophica* I find this same first chapter inserted, though not in connexion with the general title, among the *Impetus Philosophici*, and followed by another which is headed simply *Caput secundum*, without any other description; whence I conclude that the two were found by Gruter together, as if forming one piece. If so, the general title, which certainly belongs to the first, may be safely extended to both: and accordingly they are printed here as the first and second chapters of the *Temporis Partus Masculus*.

But in another part of Gruter's book, — *i. e.* on the back of the titlepage and placed there by itself as a kind of frontispiece to the volume, — I find a short Latin prayer, with the words "TEMPORIS PARTUS MASCULUS, *sive Instauratio Magna imperii humani in Universum*," printed at the head of it. And as this title cannot be applied with any propriety to the general contents of the volume, I conclude that the prayer in question was found by Gruter so headed, on a separate sheet; and that he placed it there by itself, not knowing what particular piece to connect it with. The manuscript of *Valerius Terminus* removes the difficulty. Knowing as we do the proper title of the two chapters above mentioned, we need not hesitate to connect the prayer with them, and to place it in front of them; where, though very likely written later, it was probably intended to stand.

So far I follow the example of M. Bouillet. But with regard to two other fragments — namely the *Aphorismi et Consilia*, and the *De Interpretatione Naturæ Sententiæ XII.* — which he has included under the same title, I find no sufficient authority for his proceeding. If indeed the typographical arrangement of Gruter's volume could be trusted as a true indication of the arrangement of the manuscripts from which he printed it, we should be obliged to consider the *Sententiæ XII.* as immediately connected with the chapter headed *Tradendi Modus Legitimus*, and introductory to it. But his book is put together with so little care or skill in that respect, and shows so little editorial capacity of any kind, that I do not think any such inference can be safely drawn. And I see no apparent connexion between the two writings except such as necessarily

arises from their relation to a common subject, and from their being both addressed to a disciple, or son.

With regard to the date of composition, it will be observed that my reasons for connecting the *Temporis Partus Masculus* with the *Valerius Terminus* and placing it next in order to the *Advancement of Learning*, apply only to the first chapter and the general design as indicated in the title. The *second* chapter may, for anything that appears, have been added at a much later period. And I am myself much inclined to suspect that it was not written before the summer of 1608.

Its object is to explode the various philosophical systems or theories which had been previously propounded; being the first and principal part of the doctrine of the Idols of the Theatre, — a part which, though not directly noticed in the *Advancement of Learning*, assumed soon after so prominent a place in Bacon's scheme that he resolved to place it in the very front of his battle. "Itaque *primus* imponitur labor (he says in the *Partis Secundæ Delineatio*) ut omnis ista militia theoriarum, quæ tantas dedit pugnas, mittatur ac relegetur." This *primus labor* is what he here begins with. He goes over the same ground in another paper entitled *Redargutio Philosophiarum*, and again in the *Novum Organum*. And upon a comparison of the three, there can be little doubt that this is the earliest. But besides its being more crude, there is a specific peculiarity in the style and manner of this piece which requires explanation. All Bacon's other writings are marked with the gentleness and modesty which are said to have distinguished his demeanour and conversation, and which were no doubt natural to him. In those which deal with the errors of received opinions in phi-

losophy, he is profuse even to ostentation in professions of respect and deference for the authors of them, and in disclaiming for himself all pretensions to rivalry in abilities or authority. Here for once he assumes a tone quite different; entering abruptly into the subject in a spirit of contemptuous invective, not to call it presumptuous and insolent, of which in all his writings, public or private, I remember no other example. How is this to be accounted for? I cannot help thinking that it was one of those *experiments* which I have spoken of in my general preface to the third part of the Philosophical works, — experiments in the art of commanding audiences and winning disciples, — and that the key to the true explanation of it may be found in a memorandum set down by himself in July 1608. To assist his memory, and perhaps also to excite his thoughts, he was in the habit of jotting down in commonplace books such reflexions and suggestions as occurred to him on the sudden. These he would review from time to time, and enter in a fresh book such of them as he thought worth preserving. At the end of July 1608, the business of term being over and a considerable accession to his income having just fallen in, he seems to have spent three or four days in this occupation, — reviewing all his affairs in turn and endeavouring to set the clock of his life anew; and the record of his meditations has fortunately been preserved. This is the book to which I have already so often referred by the name of *Commentarius Solutus*, and which will be printed in its place among the Occasional Works. The notes which it contains, and which are evidently set down solely for his own private memory and instruction, refer to a great variety of subjects; among which the progress

of his philosophy has a prominent place. Of these a large proportion are in the nature of queries and points for consideration; as for instance, what parts of the work to proceed with next, and how; what persons to seek acquaintance with for assistance and co-operation; what points to press and what opinions to nourish and work upon, and the like; all set down promiscuously as they occurred. Among the rest I find the following: "*Discoursing scornfully* of the philosophy of the Grecians, with some better respect to the Ægyptians, Persians, Caldees, and the utmost antiquity, and the mysteries of the poets;" and again, a little further on, "*Taking a greater confidence and authority* in discourses of this nature, *tanquam sui certus et de alto despiciens.*"

Now putting these two memoranda together, we see the germ of an idea which might easily and naturally lead to the composition, as an experiment, of the second chapter of the *Temporis Partus Masculus*. Finding that the simple proposition of his views was not winning converts, he had a mind to try what effect might be produced by putting them forward in a tone of confidence and superiority, and so threw his argument into the form in which we have it here. The idea was not absurd: for it is not less true in speculative than in practical matters that the short way to obtain authority among men is to assume it boldly; and the text "If a man come in his own name him ye will receive," though applied by Bacon to the Aristotelian philosophy as contrasted with his own, has in fact been verified not less remarkably in himself. This first experiment however he seems to have regarded as a failure; for he soon after recast the argument in another form, leaving out all that was scornful and offensive towards others, and

retaining only that tone of lofty confidence in the worth of his own speculations which grew naturally out of his profound conviction of their truth.

I have thought this conjecture of mine worth recording, because if this be the true history of the composition it gives it a new and peculiar interest, and should be taken along with us as we read. It has however another interest besides, as containing many opinions which Bacon has not expressed elsewhere; and though the manner of announcing them is affected, the opinions are no doubt his own, — whatever be the value of them.

The notes to this work are all Mr. Ellis's.

J. S.

TEMPORIS PARTUS MASCULUS

SIVE

INSTAURATIO MAGNA IMPERII HUMANI IN UNIVERSUM.

Ad Deum Patrem, Deum Verbum, Deum Spiritum, preces fundimus humillimas et ardentissimas, ut humani generis ærumnarum memores et peregrinationis istius vitæ nostræ in qua dies malos et paucos terimus, nova adhuc refrigeria e fontibus bonitatis suæ ad miserias nostras leniendas aperiant; atque illud insuper, ne humana divinis officiant, neve ex reseratione viarum Sensus et accensione majore luminis Naturalis aliquid incredulitatis et noctis animis nostris erga divina mysteria oboriatur; sed potius ut ab Intellectu a phantasiis et vanitate puro et repurgato, et divinis oraculis nihilominus subdito et prorsus dedititio, Fidei dentur quæ Fidei sunt.

TEMPORIS PARTUS MASCULUS,

SIVE DE INTERPRETATIONE NATURÆ LIB. 3.[1]

1. Perpolitio et applicatio mentis.
2. Lumen Naturæ; seu formula Interpretationis.
3. Natura Illuminata; sive veritas rerum.

CAPUT PRIMUM.

Tradendi modus legitimus.

Reperio (fili) complures in rerum scientia quam sibi videntur adepti vel proferenda vel rursus occultanda, neutiquam e fide sua ac officio se gerere. Eodem damno, licet culpa fortasse minore, peccant et illi, qui probe quidem morati sed minus prudentes sunt, nec artem ac præcepta tenent quo quæque modo sint proponenda. Neque tamen de hac tradentium scientias sive malignitate sive inscitia querela est instituenda. Sane si rerum pondera docendi imperitia fregissent, non immerito quis indignetur; rerum vero ineptiis docendi importunitatem vel jure deberi existimandum est. Ego autem longe ab his diversus te[2] impertiturus, non

[1] *i. e. libri tres.* — *J. S.*

[2] *te* ought to be *tibi*. Bacon perhaps thought that *impertio*, being here used as a verb of teaching, might govern an accusative of the person. But there seems to be no authority for this construction. [I suspect *te* to be merely a miscopy for *et*. — *J. S.*]

ingenii commenta, nec verborum umbras, nec religionem admistam, nec observationes quasdam populares, vel experimenta quædam nobilia in theoriæ fabulas concinnata; sed revera naturam cum fetibus suis tibi addicturus et mancipaturus; num videor dignum argumentum præ manibus habere, quod tractandi vel ambitione vel inscitia vel vitio quovis polluam? Ita sim (fili) itaque humani in universum imperii angustias nunquam satis deploratas ad datos fines proferam (quod mihi ex humanis solum in votis est), ut tibi optima fide, atque ex altissima mentis meæ providentia, et exploratissimo rerum et animorum statu, hæc traditurus sim[1] modo omnium maxime legitimo. Quis tandem (inquies) est modus ille legitimus? Quin tu mitte artes et ambages, rem exhibe nudam nobis, ut judicio nostro uti possimus. Atque utinam (fili suavissime) eo loco sint res vestræ, ut hoc fieri posset. An tu censes, cum omnes omnium mentium aditus ac meatus obscurissimis idolis, iisque alte hærentibus et inustis, obsessi et obstructi sint, veris rerum et nativis radiis sinceras et politas areas adesse? Nova est ineunda ratio, qua mentibus obductissimis illabi possimus. Ut enim phreneticorum deliramenta arte et ingenio subvertuntur, vi et contentione efferantur, omnino ita in hac universali insania mos gerendus est. Quid? leviores illæ conditiones, quæ ad legitimum scientiæ tradendæ modum pertinent, an tibi tam expeditæ et faciles videntur? ut modus innocens sit, di est, nulli prorsus errori ansam et occasionem præbeat? ut vim quandam insitam et innatam habeat tum ad fidem conciliandam, tum ad pellendas injurias temporis, adeo ut scientia ita tradita veluti planta vivax et vegeta quotidie serpat et adolescat? ut

[1] So in the original; a mistake probably for *sum*. — *J. S.*

idoneum et legitimum sibi lectorem seponat, et quasi adoptet? Atque hæc omnia præstiterim necne, ad tempus futurum provoco.

CAPUT SECUNDUM.

PLANE autem non dissimulo (fili) mihi quopiam submovendos esse philosophastros istos poëtis ipsis fabulosiores, stupratores animorum, rerum falsarios, et multo etiam magis horum satellites et parasitos, professoriam illam et meritoriam turbam. Quis carmen præit, ut hos[1] oblivioni devoveam? quod enim veritati silentium, si isti brutis suis et inarticulatis rationibus obstrepant? Verum tutius forsitan fuerit nominatim eos damnare, ne, cum tanta authoritate vigeant, non nominati excepti videantur; neve quis putet cum inter ipsos tam gravia et internecina exerceantur odia et tanta dimicatione certetur, me ad has larvarum et umbrarum pugnas alteri parti velut subsidio missum. Itaque citetur Aristoteles, pessimus sophista, inutili subtilitate attonitus, verborum vile ludibrium.[2] Ausus etiam, tum cum forte mens humana ad veritatem aliquam casu

[1] [*hoc* in original.] The meaning of the phrase is, "Who will repeat before me the form of words whereby I may devote these persons to oblivion?" *hoc* being manifestly a wrong reading for *hos*. Compare Liv. viii. 9: Agedum pontifex publicus populi R. *præi verba quibus me pro legionibus devoveam.*

[2] Compare what Bacon has himself said in the *Redargutio Philosophiarum:* "Itaque hos duos viros, Platonem et Aristotelem, si quis inter maxima mortalium ingenia non numerat, aut minus perspicit aut minus æquus est." "There never breathed," says Selden in speaking of Aristotle, "that person to whom mankind was more beholden." (*Table Talk*, § *Truth*): a statement which is certainly much nearer the truth than that of the text.

quopiam tanquam secunda tempestate delata acquiesceret, injicere durissimas animis compedes, artemque quandam insaniæ componere, nosque verbis addicere. Quin et ex istius sinu educti nobis sunt ac enutriti vaferrimi illi nugatores, qui cum a perambulatione mundana ac omni rerum ac historiæ luce se avertissent, ex hujus maxime præceptorum et positionum ductili admodum materia, et ingenii inquieta agitatione, numerosissimas scholarum quisquilias nobis exhibuere. Iste autem horum Dictator tanto illis accusatior, quod etiam in historiæ apertis versatus, subterraneæ alicujus specus opacissima idola retulit; atque super ipsam quidem historiam rerum particularium quasdam veluti operas aranearum extruxit, quas causas videri vult, cum sint nullius prorsus roboris vel pretii. Quales etiam nostra ætate multa cum satagentia fabricavit Hieronymus Cardanus, uterque rebus ac sibi discors. Ne vero (fili) cum hanc contra Aristotelem sententiam fero, me cum rebelle ejus quodam neoterico Petro Ramo conspirasse augurere. Nullum mihi commercium cum hoc ignorantiæ latibulo,[1] perniciosissima literarum tinea, compendiorum patre, qui cum methodi suæ et compendii vinclis res torqueat et premat, res quidem, si qua fuit, elabitur protinus et exilit; ipse vero aridas et desertissimas nugas stringit. Atque Aquinas quidem cum Scoto et sociis etiam in non rebus rerum varietatem effinxit, hic vero etiam in rebus non rerum solitudinem æquavit. Atque hoc hominis cum sit, humanos tamen usus in ore habet impudens, ut mihi etiam pro

[1] From Ramus however Bacon derived some part of his philosophical terminology; particularly his use of the word *axioma* as equivalent to *enuntiatum*. It is to be observed that he has mentioned Ramus's system, at least a portion of it, with commendation both in *Valerius Terminus* and in the *De Augmentis*.

sophistis prævaricari videatur. Verum hos missos faciamus. Citetur jam et Plato, cavillator urbanus, tumidus poëta, theologus mente captus. Tu certe dum rumores nescio quos philosophicos limares et simul committeres, ac scientiam dissimulando simulares, animosque vagis inductionibus tentares et exsolveres, vel literatorum vel civilium virorum conviviis sermones, vel etiam sermonibus quotidianis gratiam et amorem subministrare potuisti. Verum cum veritatem humanæ mentis incolam veluti indigenam nec aliunde commigrantem mentireris, animosque nostros, ad historiam et res ipsas nunquam satis applicatos et reductos, averteres, ac se subingredi, ac in suis cæcis et confusissimis idolis volutare contemplationis nomine doceres, tum demum fraudem capitalem admisisti. Deinde etiam tu scelere haud minore stultitiæ apotheosin introduxisti, et vilissimas cogitationes religione munire ausus es. Nam levius malum est, quod philologorum parens extitisti, ac tuo ductu et auspiciis plurimi, ingenii fama et cognitionis rerum populari et molli jucunditate capti et contenti, severiorem veri pervestigationem corruperunt. Inter quos fuere Marcus Cicero et Annæus Seneca et Plutarchus Chæroneus, et complures alii neutiquam his pares. Nunc ad Medicos pergamus. Video Galenum, virum angustissimi animi, desertorem experientiæ, et vanissimum causatorem. Tune, Galene, is es, qui medicorum inscitiam et desidiam etiam infamiæ eximis, et in tuto collocas, artis ac officii eorum finitor ignavissimus? qui tot morbos insanabiles statuendo, tot ægrotorum capita proscribis, horumque spem, illorum industriam præcidis? O canicula! O pestis! Tu mistionis commentum naturæ prærogativam;[1] tu inter calores

[1] Galen contrasts the inwardly formative power of nature with the (so

astri et ignis seditionem avide arripiens et ostentans, ubique humanam potestatem malitiose in ordinem redigis, et ignorantiam desperatione in æternum munire cupis. Do indignitati tuæ ne te amplius morer. Abducas etiam tecum licet socios tuos et fœderatos Arabes, dispensatoriorum conditores, qui, pari cum cæteris in theoriis amentia, copiosius quidem e supinissimis conjecturis medicinarum vulgarium pollicita magis quam auxilia composuere. Nec non cape comites perfunctoriam Neotericorum turbam. Heus nomenclator, suggere. Atqui respondet, ne dignos esse quorum nomina teneat. Sane ut inter hujuscemodi nugatores gradus quosdam agnosco, pessimum et absurdissimum genus eorum, qui methodo et acribologia universam artem comprehendunt, quibus vulgo ob elocutionem et ordinem applauditur; qualis est Fernelius.[1] Minus incommodi sunt, qui majorem observationum et experimentorum varietatem et proprietatem ostendunt, licet stultissimis causationibus dilutam et immersam, ut Arnoldus de Villa Nova, et alii id genus.[2] Intueor ab

to speak) external operations of art, in his treatise *De Natural. Facultatibus.* See vol. ii. p. 82. of Kühn's edition of Galen. He elsewhere points out the differences which he conceives to exist between animal heat and that of a fire; but I am not aware that he speaks of the heterogeneity of terrestrial and astral heat. See his treatise De Marasmo, c. 4.

[1] Fernelius, who was born near the close of the fifteenth century, and who died in 1558, was physician to Henry II. He was greatly distinguished both as a writer on medicine and as a physician. He was moreover, notwithstanding the contempt with which he is here mentioned, well seen in mathematical and natural science, and was the first person who in modern times attempted to determine the magnitude of the earth. He seems to have been singularly diligent in his calling and in his studies; and it is said that when he was advised to give himself more time for repose, he would make answer in the words of Ovid, "Longa quiescendi tempora fata dabunt."

[2] Arnaldus de Villâ Novâ lived towards the end of the thirteenth century. He was an alchemist, and was accused of being a magician. It is

altera parte cohortem Chymistarum, inter quos se ante alios jactat Paracelsus, qui audacia meruit ut separatim coërceatur. Atque superiores illi, quos modo perstrinximus, mendacia; tu monstra. Quæ tu novis Bacchi oracula in meteoricis fundis, æmule Epicuri?[1] Ille tamen in hac parte tamquam indormiscens et aliud agens opiniones veluti sorti committit. Tu omni sorte stultior in absurdissimi cujusque mendacii verba jurare paratus es. Verum alia tua videamus. Quas tu fructuum elementorum tuorum inter se imitationes? quas correspondentias? quæ parallela somnias, idolorum conjugator fanatice? Nam hominem scilicet pantomimum effecisti.[2] Quam præclaræ autem sunt interpunctiones illæ quibus naturæ unitatem lacerasti, species nimirum tuæ? Quare facilius Galenum fero elementa sua ponderantem, quam te somnia tua ornantem. Illum enim occultæ rerum proprietates, te communes et promiscuæ qualitates ex-

said that he professed medicine at Montpellier; and probably he took his name from Villeneuve, which is not far from it. Brantôme (De la Vue, &c.) makes Raymond Lully his disciple. Villa Nova's best known work is the commentary on the *Regimen Sanitatis Scholæ Salernitanæ*. Sir Alexander Croke has given some specimens of it in his edition of the *Regimen*. It is in some places sufficiently fanciful. The line

Unica nux prodest, nocet altera, tertia mors est.

of which the real meaning seems plain, is made to imply that the nutmeg or *nux moschata* is medicinal, the walnut unwholesome, and the nut or catch of the crossbow deadly. In the phrase "alii id genus" it is probable that a reference is intended to Roger Bacon.

[1] This very obscure sentence appears to be corrupt. It is probable that *novis* ought to be *novi* or *novioris*. But it is difficult with any probable alteration to obtain an intelligible meaning. [For *novis* read *nobis*? —*J. S.*]

[2] Paracelsus's doctrine of the microcosm is here alluded to. It recurs throughout his writings, but is stated more definitely than usual in the first book of his Philosophia Sagax, ii. p. 532. of his philosophical writings. See the same work, p. 553. for a statement of the fruits educed from each of the four elements by the generating power of the sun.

agitant.[1] Nos interim miseros, qui inter tam odiosas ineptias degimus! Principiorum autem triadem,[2] commentum haud ita prorsus inutile et rebus aliqua ex parte finitimum, quam importune inculcat homo impostura peritissimus? Audi adhuc crimina graviora. Tu divina naturalibus, sacris profana, fabulis hæreses miscendo, veritatem (sacrilege impostor) tum humanam tum religiosam polluisti. Tu lumen naturæ (cujus sanctissimum nomen toties impuro ore usurpas) non abscondisti, ut Sophistæ, sed exstinxisti. Illi experientiæ desertores, tu proditor. Tu evidentiam rerum crudam et personatam contemplationi ex præscripto subjiciens, et substantiarum Proteos pro motuum calculis quærens, scientiæ fontes corrumpere et humanam mentem exuere conatus es; et ambages et tædia experimentorum, quibus Sophistæ adversi, Empirici impares sunt, novis et adscititiis auxisti; tantum abest ut experientiæ repræsentativam secutus sis, aut noveris. Nec non Magorum hiatus ubique pro viribus amplificasti, importunissimas cogitationes spe, spem promissis premens, imposturæ tum artifex tum opus. Invideo tibi (Paracelse) e sectatoribus tuis unum Petrum Severinum,[3] virum non dignum qui istis ineptiis immoriatur.

[1] The meaning is that Galen seeking to explain the qualities of bodies by means of the qualities of the elements of which the bodies are composed, lost sight of or neglected all which cannot be thus explained whereas Paracelsus, by referring them to the specific and peculiar nati of the body, made it impossible to arrive at any general conclusion especting them, since the qualities of each body were to him ultimate facts.

[2] Namely salt, sulphur, and mercury.

[3] Peter Severinus was born in 1542 at Ripen in Denmark, and died in 1602. Neither Haller nor Sprengel speak of him as favourably as Bacon; nor does he seem to have had any great share of reputation; at least he is not mentioned in the common biographical dictionaries. His only known work is the *Idea Medicinæ Philosophicæ*, to which Bacon here refers. He is not to be confounded with M. A. Severinus.

Tu certe, Paracelse, ei plurimum debes, quod ea quæ tu (asinorum adoptive) rudere consueveras, cantu quodam et modulatione, et gratissimo vocum discrimine, jucunda et harmonica effecit, et mendaciorum odia in fabellæ oblectamenta traduxit. Tibi vero, Severine, veniam do, si Sophistarum doctrinam, non solum operum effœtam, verum desperationem ex professo captantem pertæsus, alia rebus nostris labentibus firmamenta quæsivisti. Cumque Paracelsica ista se obtulissent et ostentationum præconiis et obscuritatis subterfugiis et religionis affinitatibus et alio fuco commendata, te in hos,[1] non rerum fontes sed spei hiatus, jactu quodam indignationis dedisti. Rite et ordine feceris, si ab ingenii placitis ad naturæ scita te transtuleris, tibi non modo artem brevem sed et vitam longam porrectura. Jam cæteros Chymistas sententia in Paracelsum lata defixos cerno obstupescere. Agnoscunt profecto decreta sua, quæ iste magis promulgavit quam posuit, ac arrogantia pro cautelis (haud plane ex antiqua disciplina) communivit: ubi sane magna mentiendi reciprocatione inter se conciliati largas ubique spes ostentant, et per experientiæ quidem devia vagi, in quædam utilia, casu non ductu, quandoque impinguntur. In theoriis vero iisdem[2] ab arte sua (utpote fornacis discipuli) non recesserunt. Verum ut delicatus ille adolescentulus, cum scalmum in littore reperisset, navem ædificare concupivit; ita carbonarii isti ex pauculis distillationum experimentis philosophiam condere aggressi sunt, ubique istis separationum et liberationum absentissimis[3] idolis obnoxiam. Nec hos tamen uno ordine omnes habeo.

[1] *hoc* in original. — *J. S.*
[2] So in original. qu. *iidem*? — *J. S.*
[3] So in original. — *J. S.*

Siquidem utile genus eorum est, qui de theoriis non admodum solliciti, mechanica quadam subtilitate rerum inventarum extensiones prehendunt; qualis est Bacon.[1] Sceleratum et sacrum eorum, qui undique theoriis suis plausus conquirunt, ambientibus etiam et pro iis supplicantibus religione, spe, et impostura. Talis est Isaac Hollandus,[2] et turbæ Chymistarum pars longe maxima. Age citetur jam Hippocrates, antiquitatis creatura et annorum venditor. In cujus viri authoritatem cum Galenus et Paracelsus magno uterque studio, velut in umbram asini, se recipere contendat, quis non cachinnum tollat? Atque iste homo certe in experientia obtutu perpetuo hærere videtur, verum oculis non natantibus et anquirentibus, sed stupidis et resolutis. Deinde a stupore visu parum recollecto, idola quædam, non immania quidem illa theoriarum, sed elegantiora ista quæ superficiem historiæ circumstant, excipit;

[1] Roger Bacon, whom his namesake has here so faintly praised, was beyond all doubt one of the greatest men of the age in which he lived. He was born in 1214 at Ilchester, and died in 1292 or 1294. One of the most remarkable circumstances connected with him is the influence which a passage in the *Opus Majus* exercised on Columbus, who perhaps had never heard of him. Peter de Alliaco, whose *Imago Mundi* was compiled in 1410, transcribed almost literally, but without acknowledgment, from Roger Bacon a passage (containing quotations in favour of the possibility of reaching India by sailing westward, from Aristotle, Pliny, and Seneca) which seems to have made a profound impression on Columbus; who, as Humboldt remarks, was familiar with the *Imago Mundi*. Compare the three passages; viz. the passage in the *Opus Majus*, that in the *Imago Mundi*, and that contained in the letter which Columbus wrote to Ferdinand and Isabella from Haiti, given by Humboldt, vol. i. p. 65. of his *Examen Critique de l'Histoire de la Géographie*.

[2] Very little is known of Isaac Hollandus. He is said by Suertius (*Athenæ Belgicæ*) to have been a native of the Netherlands, and to have published in 1582 a work entitled "Abdita quædam de Opere Animali et Vegetabili." But Sprengel speaks of Isaac Hollandus as one of the precursors of Paracelsus. There is also a John Isaac, said to be a son of Isaac's. See Sprengel Hist. Medic. iii. 270. I have not seen Adami, to whom Sprengel refers.

quibus haustis tumens et semisophista, et brevitate (de illius ætatis more) tectus, oracula demum (ut his placet) pandit, quorum ii se interpretes haberi ambiunt; cum revera nihil aliud agat, quam aut sophistica quædam per abruptas et suspensas sententias tradens redargutioni subducat, aut rusticorum observationes supercilio donet. Atque ad hujus quidem viri instituta, non tam improba quam inutilia, proxime (ut etiam vulgo creditur) accedit Cornelius Celsus; sed intentior sophista, et historiæ modificatæ magis obstrictus, idem moralem moderationem scientiæ progressibus aspergens, et errorum extrema amputans, non prima evellens. Atque de istis verissima quidem hæc sunt. Nunc autem sciscitantem te audio (fili) an non forte deteriora, ut fit, voluere; præsertim cum status scientiæ sit semper fere democraticus? An non tempus veluti flumen levia et inflata ad nos devexit, solida et gravia demersit? Quid veteres illi veritatis inquisitores Heraclitus, Democritus, Pythagoras, Anaxagoras, Empedocles, et alii, alienis non propriis scriptis noti? Quid denique de silentio et secretis antiquitatis statuis? Ego (fili) ut tibi (ex more meo, id est usu tuo) respondeam, antiquitatis fragmentum unum aut alterum (inventorum dico non librorum) agnosco: idque ipsum tamen magis ut diligentiæ et ingenuitatis specimen, quam scientiæ authoris. De iis vero rebus, quæ cum vestigiis suis aufugere, si innuerem laboriosa esse ista conjecturarum aucupia, nec consentaneum me utilitates in posterum humano generi parantem ad antiquitatis philologiam retrogredi, sat scio pro modestia tua acquiesceres. Veruntamen ut perspicere possis quam res præsentes bifrontes vates sint, quamque et futuras et præteritas coram sistant, decrevi utriusque temporis tabulis (quæ

non tantum scientiæ decursus et fluxus, sed et alios rerum provisus complectantur) tibi gratificari. Neque tu hoc quale sit (antequam videas) augurere; non enim cadit in te vera hujusce rei anticipatio; nec si minus ad manus tuas veniat, requiras. Gratificor enim (inquam) quibusdam vestrum hac in re (fili) et delicatioribus spiritus concilio. Omnino scientia ex naturæ lumine petenda, non ex antiquitatis obscuritate repetenda est. Nec refert quid factum fuerit; illud videndum, quid fieri possit. An tu, si regnum tibi armis et victori bello subjugatum traderetur, quæstiones necteres utrum majores tui illud tenuerint necne, et genealogiarum rumores solicitares? Atque hæc de antiquitatis penetralibus dicta sunt. De istis vero sectarum ducibus, quos nominasti, et compluribus aliis id genus, facilis sententia est. Errori varietas, veritati unitas competit. Ac nisi temporum politiæ et provisus ejusmodi ingeniorum peregrinationibus adversiores extitissent, multæ etiam aliæ errorum oræ fuissent peragratæ. Immensum enim pelagus veritatis insulam circumluit; et supersunt adhuc novæ ventorum idolorum injuriæ et disjectiones. Quinetiam nudiustertius Bernardinus Telesius scenam conscendit, et fabulam novam egit, nec plausu celebrem, nec argumento elegantem. An non vides (fili) tum eccentricorum et epicyclorum ingeniatores, tum terræ aurigas, æqua et ancipiti phænomenorum advocatione gaudere? Prorsus ita et in universalibus theoriis fit. Nam veluti si quis lingua tantum vernacula uti sciens (adverte, fili, nam simile est admodum) scripturam ignoti sermonis capiat, ubi paucula quædam verba sparsim observans suæ linguæ vocabulis sono et literis finitima, illa quidem statim ac fidenter ejusdem esse significationis ponit (li-

cet ab ea sæpius longissime recedant), postea ex iis invicem collatis reliquum orationis sensum multo ingenii labore, sed et multa libertate, divinat; omnino tales et isti naturæ interpretes inveniuntur. Nam idola quisque sua (non jam scenæ dico, sed præcipue fori et specus[1]), veluti linguas vernaculas diversas, ad historiam afferentes, confestim quæ simile aliquid sonant arripiunt; cætera ex horum symmetria interpretantur. Atque jam tempus est (fili) ut nos recipiamus et expiemus, utpote qui tam profana et polluta (licet importandi[2] animo) attrectaverimus. Ego vero adversus istos omnes minora quam pro ipsorum sontissimo reatu dixi. Tu tamen fortasse minus istam redargutionem intelligis. Nam pro certo habeas (fili) sententias istas quas adversus istos tuli, nihil minus esse quam contumeliam. Ego enim non ut Velleius apud Ciceronem, declamator et philologus opiniones cursim perstringens, et magis abjiciens quam frangens; vel ut Agrippa, neotericus homo, in istiusmodi sermone ne nominandus quidem, sed trivialis scurra, et singula distorquens et lusui propinans (me miserum, qui hominum defectu cum brutis me conferre necesse habeam!);[3] ita me gessi. Verum

[1] Only three species of idols are here noticed — that of the tribe being omitted. In the *Advancement of Learning* three kinds of idols are mentioned, but not by name. It seems however as if the third kind includes two of the species mentioned in the *Novum Organum;* namely the idols of the forum, and those of the theatre. In *Valerius Terminus* four kinds of idols are mentioned: those here and subsequently called idols of the forum being there called idols of the palace.

[2] *improbandi?*

[3] Of Cornelius Agrippa, thus contemptuously condemned, Jöcher's judgment is "Er war ein aufrichtiger, unerschrockener und grossmüthiger Mann. Seine Naturgaben waren ganz besonder, und seine Erfahrenheit in allen Wissenschaften ungemein." He was born at Cologne in 1486, and died in 1535. His best known work is the treatise *De Incertudine et Vanitate Scientiarum* from which Bacon has apparently borrowed, though not largely, in the *Advancement of Learning.*

sub maledicti velo miras accusationum animas, et singulari artificio in singula fere verba contractas et reductas, et exquisitissima oculi acie in ipsa criminum ulcera directas et vibratas, postmodum respiciens videbis. Atque cum isti criminibus et reatu valde inter se mixti et implicati forent, tamen singulos indiciis maxime propriis, iisdem autem capitalibus, reos feci. Mens enim humana (fili) rerum incursibus et observationibus turgida varias admodum errorum species molitur et educit. Aristoteles vero velut unius est speciei planta procerior, sic et Plato, et alii deinceps. At confutationes particulares requiris. Næ illud peccatum fuerit largiter in humani generis *fortunam auream*, pignus imperii, si ego ad umbrarum fugacissimarum insecutionem deflecterem. Unum (fili) in medio ponendum est veritatis lumen clarum et radiosum, quod omnia collustret, et errores universos momento dispellat. Non infirmi quidam et pallidi lychni ad singulos errorum et mendaciorum angulos et sinus circumferendi sunt. Quare quod petebas detestare (fili), nam profanum est valde. Subinde vero interrogantem te audio: num quæ isti universi asseruerunt, omnia prorsus vana et falsa fuere? Atqui (fili) infelicitatem jam narras, eamque prodigiosam non ignorantiam. Nemo enim non quandoque in aliquod verum impingitur. Heraclitum, cum scientiam ab hominibus in mundis privatis, non in mundo communi, quæsitam diceret, bene in philosophiæ introitu litasse video.[1] Democritum, cum naturæ immensam varietatem et infinitam successionem tribuens, se e regione sisteret cæterorum fere philosophorum, *secularitatibus* deditissimorum, et mancipiorum consuetudinis, et hac oppositione utrumque mendacium in se collidendo per-

[1] Vol. II. p. 139. note 1.

deret, et veritati inter extrema viam quandam aperiret, non infeliciter philosophatum esse reputo. Pythagoræ numeros etiam boni ominis loco pono. Dindamum Indum quod morem Antiphysin dixerit, laudo.[1] Quin et Epicurum adversus causarum (ut loquuntur) per intentiones et fines explicationem disputantem, licet pueriliter et philologe, tamen non invitus audio. Etiam Pyrrhonem et Academicos vacillantes, et e lintre loquentes, et erga idola se gerentes veluti amatores quosdam morosos (qui amasios suos semper probris afficiunt, nunquam deserunt), animi et hilaritatis gratia adhibeo. Nec immerito; cæteros enim idola prorsum agunt, hos vero in orbem; quod jocosius est. Denique Paracelsum et Severinum cum tantis clamoribus homines ad experientiæ suggestum convocant, præcones mihi exopto.[2] Quid igitur? Num veritatis compotes isti? Nihilo minus. Et rusticorum (fili) proverbia nonnulla apposite ad veritatem dicuntur. Sus rostro si forte humi A literam impresserit, num propterea suspicabere integram tragœdiam, veluti literam unam, ab ea posse describi? Longe alia est ratio (fili) veritatis quæ est ex scientiæ analogia, alia quæ ex idoli sectione enuntiatur.[3] Illa constans et quota gemina, hæc discors et solitaria. Quod etiam in operibus fit. Pulvis tormentorum si ductu, non casu (ut loquuntur) et im-

[1] Vol. III. p. 177. note 1.

[2] To this somewhat short list of things which he could commend, Bacon might have added the motto which a Chinese philosopher put up in his library—"Fei, Fei:" "Reject what is false;" by which he meant to imply that the rejection of what is false is a better road to knowledge than "She, She" — or the direct assertion of what is true; Bacon's own method being based as he often says on negation and exclusion. The name of this Chinese philosopher was Ngheou-Yang-Sieou. See Premare, Notitia Linguæ Sinicæ, p. 203.

[3] That is, I believe, "in cases in which the fantastical hypothesis, idolum, cuts in upon or intersects (secat) the truth."

pactu inventum fuisset, non solitarium, sed cum multa inventorum nobilium (quæ sub eundem meridianum cadunt) frequentia prodiisset. Sic et alia, tum opera tum posita. Quare moneo, si forte idolum aliquod alicujus istorum meam (id est, rerum) veritatem aliquo in puncto secuerit, noli aut de iis majora, aut de me inferiora cogitare, cum satis appareat ex reliquorum ignoratione ipsa illa, non ex scientiæ analogia, eos dixisse. Adhuc instas (fili) num ergo universas istorum chartas thuri et odoribus amicula fieri jubeo?[1] Non illud dixerim. Manet enim paulisper aliquis eorum usus, tenuis quidem et angustus, et longe alius quam in quem destinatæ erant ac nunc usurpantur, sed tamen aliquis. Adde et alias multas chartas illis celebritate obscuriores, usu præstantiores esse. Aristotelis et Platonis moralia plerique mirantur; sed Tacitus magis vivas morum observationes spirat. Verum quæ tandem utilitas ex chartis capi possit, quæque aliæ aliis utilitate antecedant, quæque minima pars sint chartarum munera, eorum quæ ad interpretationem naturæ conferunt, suo loco dicetur. Postremo (fili) ita te quærentem audio: num tu te in istorum omnium locum sufficis? Respondebo, atque id [non] dissimulanter, et ex intimo sensu meo. Ego (fili suavissime) tibi sanctum, castum, et legitimum connubium cum rebus ipsis firmabo. Ex qua consuetudine (supra omnia epithalamiorum vota) beatissimam prolem vere Heroum (qui infinitas humanas necessitates, omnibus gigantibus, monstris, et tyrannis exitiosiores, subacturi sunt, et rebus vestris placidam et festam securitatem et copiam conciliaturi) suscipies. Ego vero (fili) si te jamjam animo ab idolis non repurgato vertiginosis experientiæ ambagibus committerem, næ tu

[1] *jubes* in the original. — *J. S.*

ducem cito desiderares. Idola autem exuere simplici præcepto meo sine rerum notitia, ne, si velles maxime, posses. In tabulis nisi priora deleveris, non alia inscripseris. In mente contra: nisi alia inscripseris, non priora deleveris. Atque ut hoc fieri posset ut *idola hospitii* exueres, tamen periculum omnino est ut ab *idolis viæ* non initiatus obruare. Nimis duci assuevisti. Etiam Romæ, firmata semel tyrannide, semper postea sacramentum in senatus populique Romani nomen irritum fuit. Confide (fili), et da te mihi, ut te tibi reddam.

PARTIS INSTAURATIONIS SECUNDÆ

DELINEATIO ET ARGUMENTUM,

ET

REDARGUTIO PHILOSOPHIARUM.

PREFACE

TO THE

PARTIS INSTAURATIONIS SECUNDÆ DELINEATIO ET ARGUMENTUM.

AMONG the pieces collected by Gruter under the title *Impetus Philosophici*, the first is entitled *Indicia vera de Interpretatione Naturæ*. It consists of the preface to the *Novum Organum* (*Qui de naturâ tanquam de re exploratâ &c.*) which has already been printed Vol. I. p. 233.; the *Partis secundæ delineatio et Argumentum;* and a small portion of the *Redargutio Philosophiarum;* all three printed consecutively under the same general heading, as if they had been found together in the original manuscript and formed one composition. The last (which has no separate heading, but is printed as if it were a part of the *Delineatio*) breaks off abruptly. But a manuscript discovered by Robert Stephens among Lord Oxford's collections, and now in the British Museum,[1] enables us to complete it, and supplies the title. That it is the same writing there can be no doubt; for the first three or four pages of the manuscript are identical, or nearly so, with the last three or four printed by Gruter, and the whole fits perfectly into its place.

[1] Harl. MSS. 6855.

The *Delineatio* is a sketch of the plan of the *Novum Organum*, as then designed; and is interesting for three reasons. First, it contains the earliest intimation of the entire scheme of the *Instauratio Magna;* which Bacon had already resolved to distribute into six parts: the second to treat of the art of interpretation; the third, fourth, and sixth to exhibit the results of the art applied; and the fifth to be provisional, consisting of *anticipations* arrived at by the ordinary method, which were afterwards to be verified by the true method. All which agrees exactly with the design ultimately developed in the *Distributio Operis*. Of the first part he says nothing; perhaps because, though he had determined to introduce into it the substance of the *Advancement of Learning*, he had not yet settled the form; and this again agrees very well with my conjecture as to the history of the *De Augmentis*. Secondly, it marks a stage in the development of Bacon's philosophical theory: by comparing it with the *Valerius Terminus*, the *Cogitata et Visa*, and the *Novum Organum*, we learn something as to the changes which his design underwent as he worked it out (see Mr. Ellis's General Preface, Vol. I. p. 87., and Preface to *Novum Organum*, p. 143.). Thirdly, though it was afterwards superseded by that portion of the *Distributio Operis* which describes the contents of the second part of the *Instauratio*, it is in some places more full and particular, and the description of the *Ministratio ad Rationem* adds something to what we otherwise know concerning those parts of the inductive process which were to have been developed in the third book of the *Novum Organum*.

As to the time when it was composed, Mr. Ellis has

shown in his preface to the *Novum Organum* that it must have been written before the *Cogitata et Visa*, and as there can be no doubt that it was written after the *Advancement of Learning* and the *Valerius Terminus*, it may be referred with tolerable confidence to the year 1606 or 1607.

According to the plan sketched out in it, the work was to begin with an attempt to clear the mind from impressions derived from the philosophical theories then extant and received; and with this accordingly, the sketch of the plan being completed, the work itself begins. The *Redargutio Philosophiarum* which follows may in fact be considered as the first chapter of the second part of the *Instauratio*, as it was then designed. I therefore print them together. I would not however be understood to imply thereby that they were composed at the same time. The arguments which convince Mr. Ellis that the *Delineatio* was written before the *Cogitata et Visa* apply to the *Delineatio* only. The *Redargutio*, like the second chapter of the *Temporis Partus Masculus*, may have been composed at a much later period than the work of which it was nevertheless meant to form a part; and while the internal evidence proves almost conclusively that that second chapter was an earlier form of the *Redargutio* than this, there is a piece of external evidence which strongly inclines me to think that the idea out of which they both grew occurred to Bacon about the same time.

In my general preface to the third part of the Philosophical works I have spoken of the difficulty which Bacon found or apprehended about this time in obtaining an audience for his views, and the various

devices which he resorted to for the purpose of overcoming or avoiding them. In my preface to the *Temporis Partus Masculus* I have endeavoured to account for the tone of arrogance assumed in the second chapter, by supposing it to have been an experiment of that kind; and I have quoted two entries from the *Commentarius Solutus*, as suggesting a possible and I think not improbable explanation of it. I shall now quote, in connexion with this much improved edition of the same argument, the entire page in which one of those entries occurs. The date is July 26, 1608; and the notes run thus:

"Ordinary discourse of plus ultra in sciences, as well the intellectual globe as the material, illustrated by discovery in our age.

"Discoursing scornfully of the philosophy of the Grecians, with some better respect to the Ægyptians, Persians, Caldees, and the utmost antiquity, and the mysteries of the poets.

"Comparing the case with that which Livy sayeth of Alexander, Nil aliud quam bene ausus vana contemnere.

"Qu. of an oration ad filios; delightful, sublime, and mixed with elegancy, affection, novelty of conceit and yet sensible, and superstition.

"To consider what opinions are fit to nourish tanquam ansæ, and so to grift the new upon the old, ut religiones solent.

"Ordinary course of incompetency of reason for natural philosophy and invention of works, a pretty device to buy and sell with: Aditus non nisi sub persona infantis."

Now if the tenor of these notes, especially the fourth,

be compared with the noble oration supposed to be addressed to the assembled sages of Paris in the *Redargutio Philosophiarum*, the connexion will appear close enough, I think, to justify us in concluding that it was composed after July 1608; and this would accord very well with M. Bouillet's conjecture that this was the manuscript sent by Bacon to Tobie Matthew in a letter dated October 10, 1609, and alluded to in the following passage: "I send you at this time the only part which hath any harshness. And yet I framed to myself an opinion that whosoever allowed well of that preface which you so much commend, will not dislike, or at least ought not to dislike, this other speech of preparation. For it is written out of the same spirit and out of the same necessity. Nay it doth more fully lay open that the question between me and the ancients is not of the virtue of the race, but of the rightness of the way. And to speak truth, it is to the other but as *palma* to *pugnus* — part of the same thing, more large."

Of the matter of the oration it is not necessary to say anything, since it is all to be found either in the prefaces to the *Novum Organum*, or in the aphorisms of the first book. The form is peculiar to this composition, which exhibits as perfect a specimen as we have of Bacon's power as an artist and an orator.

I have taken the text from the manuscript (which has been revised and corrected throughout by Bacon himself, and some sentences added between the lines or in the margin), except in the part which has been printed by Gruter, and which appears to have been taken from a corrected copy. For as I find that all the alterations made by Bacon in the manuscript, with

only one exception, are contained in Gruter's copy, I infer that the differences between the two are due to further alterations made subsequently, and that the manuscript which Gruter had was the beginning of a fair transcript of later date. I have however given the readings of the Harleian manuscript in the notes: so that on this point the reader may judge for himself.

J. S.

PARTIS INSTAURATIONIS SECUNDÆ

DELINEATIO ET ARGUMENTUM.

Memores autem instituti nostri, omnia perspicue proponemus, atque ordine non perturbato. Pateat itaque hujus partis destinatio et distributio. Destinatur huic parti doctrina de meliore ac perfectiore usu rationis quam hucusque hominibus sit cognitus aut monstratus; eo consilio, ut per hoc intellectus humanus (quantum conditio mortalitatis recipit) exaltetur, et facultate amplificetur ad naturæ obscuritatem vincendam et interpretandam. Namque ipsi Interpretationi Naturæ attribuuntur libri tres; tertius, quartus, et sextus; siquidem quintus, qui ex Anticipationibus est secundum usum rationis communem, ad tempus tantum sumitur, et deinceps, postquam figi cœperit atque ex usu rationis legitimo verificari, et transfertur et commigrat in sextum. Huic vero libro secundo committitur Intellectus ipse ejusque cura et regimen, omnisque apparatus atque instructio ad veram rationis administrationem conducens describitur. Atque licet nomen ipsum Logicæ, sive Dialecticæ, propter depravationes apud nos ingratum fere sonet, tamen ut homines per consueta tanquam manu ducamus, est certe ars ea quam adducimus ex genere Logicæ, quæ et ipsa (vulgaris inquam) auxilia et præsidia intellectui parat et molitur. Differt autem

nostra a Logica vulgari, tum aliis rebus, tum præcipue tribus; videlicet initiis inquirendi, ordine demonstrandi, atque fine et officio. Nam et inquisitionis initium altius sumit, ea subjiciendo examini quæ logica vulgaris veluti ex fide aliena et authoritate cæca recipit; principia, notiones primas, atque ipsas informationes sensus; et ordinem demonstrandi plane invertit, propositiones et axiomata ab historia et particularibus ad generalia per scalam adscensoriam continenter subvehendo et excitando; non protinus ad principia et magis generalia advolando, atque ab illis medias propositiones deducendo et derivando. Finis autem hujus scientiæ est, ut Res et Opera, non argumenta et rationes probabiles, inveniantur et judicentur. Quare institutum hujus libri secundi hujusmodi est. Nunc distributionem ejusdem similiter proponemus. Quemadmodum in generatione luminis requiritur, ut corpus lumen recepturum poliatur, atque deinde in debito ad lucem situ sive conversione ponatur, antequam lucis ipsius fiat immissio; prorsus ita est operandum. Primo enim mentis area æquanda, et liberanda ab eis quæ hactenus recepta sunt; tum conversio mentis bona et congrua facienda est ad ea quæ afferuntur; postremo menti præparatæ informatio exhibenda. Atque pars destruens triplex est, secundum triplicem naturam idolorum quæ mentem obsident. Illa enim aut adscititia sunt, idque dupliciter, nimirum quæ immigrarunt in mentem eamque occuparunt, vel ex philosophorum placitis atque sectis, vel rursus ex perversis legibus et rationibus demonstrationum; aut ea quæ menti ipsi et substantiæ ejus inhærentia sunt atque innata. Sicut enim speculum inæquale veros rerum radios ex sectione propria immutat: ita et mens, quando a rebus per sensum patitur, in motibus

suis expediendis, haudquaquam optima fide, rerum naturæ suam naturam inserit et immiscet. Itaque primus imponitur labor, ut omnis ista militia Theoriarum, quæ tantas dedit pugnas, mittatur ac relegetur. Accedit labor secundus, ut mens a pravis demonstrationum vinculis solvatur. Hunc excipit tertius, ut vis ista mentis seductoria coërceatur, atque idola innata vel evellantur, vel, si evelli non possint, ita tamen indicentur atque pernoscantur ut variationes restitui possint. Inutilis enim et fortasse damnosa fuerit errorum in philosophiis demolitio et destructio, si ex prava complexione mentis novi errorum surculi, et fortasse magis degeneres, pullulaverint; neque prius absistendum, quam omnis spes præcidatur ex usu rationis communi aut ex vulgaris logicæ præsidiis et auxiliis philosophiæ absolvendæ aut majorem in modum amplificandæ; ne forte errores non abjiciamus sed permutemus. Itaque pars ista, quam destruentem appellamus, tribus redargutionibus absolvitur; Redargutione Philosophiarum; Redargutione Demonstrationum; et Redargutione Rationis Humanæ Nativæ. Neque nos fugit, absque tanto motu accessiones non parvas ad scientias a nobis fieri potuisse, atque aditu fortasse ad laudem molliore. Verum nos nescii quando hæc alicui alii in mentem ventura sint, fidem nostram in integrum liberare decrevimus. Post aream mentis æquatam, sequitur ut mens ponatur in conversione bona et veluti in adspectu benevolo ad ea quæ proponemus. Cum enim in re nova valeat ad præjudicium, non solum præoccupatio fortis opinionis veteris, verum etiam præceptio sive præfiguratio falsa rei quæ affertur, etiam huic malo remedium adhibendum est atque mens non tantum vindicanda sed et præparanda. Ea præparatio nihil aliud est quam ut veræ habeantur

de eo quod adducimus opiniones, ad tempus tantummodo, et tanquam usurariæ, donec res ipsa pernoscatur. Atque hoc in eo fere situm est, ut pravæ et sinistræ suspiciones, quales ex prænotionibus receptis (veluti ex atra bile quadam epidemica) mentes hominum subituras facile conjicimus, arceantur atque intercipiantur; quod ait ille,

ne qua
'Occurrat facies inimica, atque omina turbet.

Primo igitur si quis ita cogitet, occulta naturæ veluti signo divino clausa manere, atque ab humana sapientia interdicto quodam separari, dabimus operam ut hæc opinio infirma atque invida tollatur, eoque rem perducemus, simplici veritate freti, ut non solum ne qua oblatret superstitio, verum etiam ut religio in partes nobis accedat. Rursus si cui hujusmodi quippiam in mentem veniat opinari, magnam illam et solicitam moram in experientia et in materiæ et rerum particularium undis quam hominibus imponimus, mentem veluti in Tartarum quendam confusionis dejicere, atque ab abstractæ sapientiæ serenitate et tranquillitate, ut a statu multo diviniore, submovere; docebimus, atque in perpetuum, ut speramus, stabiliemus (non sine rubore, ut existimamus, omnis scholæ quæ meditationibus inanibus atque ab omni essentia desertissimis apotheosin quandam attribuere non veretur), quantum inter divinæ mentis ideas et humanæ mentis idola intersit. Quinetiam illis quibus in contemplationis amorem effusis frequens apud nos operum mentio asperum quiddam atque ingratum et mechanicum sonat, monstrabimus quantum illi desideriis suis propriis adversentur; cum puritas contemplationum atque substructio et inventio operum prorsus eisdem rebus nitantur, ac simul perficiantur.

Adhuc si quis hæsitet, atque istam scientiarum ab integro regenerationem ut rem sine exitu et vastam et quasi infinitam accipiat, ostendemus eam contra censeri debere potius errorum et vastitatis terminum et verum finitorem; atque planum faciemus, inquisitionem rerum particularium justam et plenam, demptis individuis et gradibus rerum et variationibus minutis (id quod ad scientias satis est), atque inde debito modo excitatas notiones sive ideas, rem esse multis modis magis finitam et habilem et comprehensibilem et sui certam, et de eo quod confectum est atque eo quod superest gnaram, quam speculationes et meditationes abstractas, quarum revera nullus est finis, sed perpetua circulatio, volutatio, et trepidatio. Atque etiamsi quis sobrius (ut sibi videri possit), et civilis prudentiæ diffidentiam ad hæc transferens, existimet hæc quæ dicimus votis similia videri, quæque spei nimis indulgeant; revera autem ex philosophiæ statu mutato nil aliud secuturum quam ut placita fortasse transferantur, res autem humanæ nihilo futuræ sint auctiores; huic fidem, ut putamus, faciemus, nil minus agi quam placitum aut sectam; nostramque rationem ab iis quæ hucusque in philosophia et scientiis præbita sunt toto genere differre; operum autem certissimam messem sponderi, ni homines muscum sive segetem herbidam demetere præoccuparint, atque affectu puerili et conatu fallaci operum pignora intempestive captaverint. Atque ex his quæ diximus pertractatis, satis cautum de præjudicio fore existimamus illius generis quod ex prava et iniqua rei quæ adducitur perceptione conflatur, atque una secundam partem, quam præparantem appellamus, absolvi; postquam et ex parte religionis, et ex parte contemplationis abstractæ, et ex parte prudentiæ naturalis, atque ejus comitatu,

diffidentia et sobrietate et similibus, omnis adversa aura conticuerit et reflare desierit. Attamen ut omnibus numeris completa adhibeatur præparatio, illud deesse videtur, ut languor ipse mentis et torpor ex rei miraculo contractus tollatur. Hæc autem mala dispositio mentis tantum per causarum indicationem aufertur. Sola enim causarum cognitio miraculum rei et stuporem mentis solverit. Itaque omnes impedimentorum malitias et molestias quibus interclusa philosophia vera remorata est signabimus, ut minime mirum sit humanum genus erroribus tam diuturnis implicatum atque exercitum fuisse. In qua parte, etiam illud opportune ad spem solido argumento fovendam patebit, nimirum licet vera illa Naturæ Interpretatio quam molimur merito maxime difficilis, tamen multo maximam difficultatis partem in iis subesse quæ in potestate nostra sunt atque corrigi possunt, non in iis quæ extra potestatem nostram sita existunt; in mente (inquam), non in rebus ipsis aut in sensu. Quod si cui supervacua videatur accurata ista nostra quam adhibemus ad mentes præparandas diligentia, atque cogitet hoc quiddam esse ex pompa et in ostentationem compositum, itaque cupiat rem ipsam, missis ambagibus et præstructionibus, simpliciter exhiberi; certe optabilis nobis foret (si vera esset) hujusmodi insimulatio. Utinam enim tam proclive nobis esset difficultates et impedimenta vincere, quam fastum inanem et falsum apparatum deponere. Verum hoc volumus homines existiment, nos haud inexplorato viam in tanta solitudine inire, præsertim cum argumentum hujusmodi præ manibus habeamus, quod tractandi imperitia perdere et veluti exponere nefas sit.

Ex perpenso et perspecto tam rerum quam animi statu, duriores fore aditus ad hominum mentes

quam ad res ipsas invenimus, ac tradendi labores inveniendi laboribus haud multo leviores experimur, atque, quod in intellectualibus res nova fere est, morem gerimus, et tam nostras cogitationes quam aliorum simul bajulamus. Omne enim idolum vanum arte atque obsequio ac debito accessu subvertitur; vi et contentione atque incursione subita et abrupta efferatur. Neque hoc ideo tantum fit, quod homines vel admiratione authorum captivi, vel propria fiducia tumidi, vel assuetudine quadam renitentes, se æquos præbere nolint. Si quis libentissime sibi æquitatem imperare voluerit atque omne præjudicium veluti ejuraverit, tamen et tali mentis dispositioni neutiquam propterea fidere oporteret. Nemo enim intellectui suo ex arbitrio voluntatis suæ imperat, neque philosophorum (ut prophetarum) spiritus philosophis subjecti sunt. Itaque non aliorum æquitas aut sinceritas aut facilitas, sed nostra propria cura atque morigeratio et insinuatio nobis præsidio esse possit. Qua in re accedit et alia quædam difficultas ex moribus nostris haud parva, quod constantissimo decreto nobis ipsi sancivimus, ut candorem nostrum et simplicitatem perpetuo retineamus, nec per vana ad vera aditum quæramus, sed ita obsequio nostro moderemur, ut tamen non per artificium aliquod vafrum aut imposturam aut aliquid simile impostura, sed tantummodo per ordinis lumen et per novorum super saniorem partem veterum solertem insitionem, nos nostrorum votorum compotes fore speremus. Itaque eo redimus, ut hanc præmuniendi diligentiam minorem potius pro tantis difficultatibus, quam minus necessariam esse judicemus. Missa autem jam parte præparante, ad partem informantem veniemus, atque artis ipsius quam adducimus figuram simplicem et nudam proponemus. Quæ

ad intellectum perficiendum ad Interpretationem Naturæ faciunt, dividuntur in tres ministrationes; ministrationem ad Sensum, ministrationem ad Memoriam, et ministrationem ad Rationem. In ministratione ad Sensum tria docebimus. Primo, quomodo bona notio constituatur et eliciatur, ac quomodo testatio sensus, quæ semper est ex analogia hominis, ad analogiam mundi reducatur et rectificetur; neque enim multum sensui tribuimus in perceptione immediata, sed quatenus motum sive alterationem rei manifestat. Secundo, quomodo ea quæ sensum effugiunt, aut subtilitate totius corporis, aut partium minutiis, aut loci distantia, aut tarditate vel etiam velocitate motus, aut familiaritate objecti, aut alias, in ordinem sensus redigantur, atque ejus judicio sistantur; ac insuper in casu quo adduci non possunt, quid faciendum, atque quomodo huic destitutioni vel per instrumenta vel per graduum observationem peritam vel per corporum proportionatorum ex sensibilibus ad insensibilia indicationes vel per alias vias ac substitutiones, sit subveniendum. Postremo loco de historia naturali, et de modo experimentandi dicemus, qualis sit ea historia naturalis quæ ad philosophiam condendam sufficere possit; et rursus qualis experimentatio deficiente historia necessario sit suscipienda: ubi etiam quædam de provocanda et figenda attentione admiscebimus. Multa enim in historia naturali atque experimentis, notitia ipsa adesse jampridem, usu abesse solent, propter vim animi apprehensivam minime excitatam. His tribus ministratio ad sensum absolvitur. Aut enim sensui materia præbetur, aut juvamentum; nimirum vel ubi deficit, vel ubi declinat. Materiæ, historia et experimenta; defectui sensus, substitutiones; declinationi, rectificationes debentur. Ministratio ad Memoriam hoc officium præs-

tat, ut ex turba rerum particularium et naturalis historiæ generalis acervo particularis historia excerpatur, atque disponatur eo ordine ut judicium in eam agere et opus suum exercere possit. Etenim vires mentis sobrie æstimandæ, neque sperandum et eæ in rerum infinitate discurrere possint. Manifestum autem est, memoriam tum in rerum multitudine comprehendenda incapacem et incompetentem, tum in rerum delectu quæ ad inquisitionem aliquam definitam faciant suggerendo, imparatam atque inhabilem esse. Quod autem ad prius malum attinet, facilis est medendi ratio; unico enim remedio absolvitur; ut nulla nisi de scripto inquisitio aut inventio recipiatur. Perinde enim est ut quis Interpretationem Naturæ in aliquo subjecto memoria sola nixus complecti velit, ac si computationes ephemeridis memoriter tenere aut perficere tentet. Quinetiam satis liquet quantum memoriæ et mentis discursui tribuamus, cum nec de scripto inventionem, nisi per tabulas ordinatas, probemus. De posteriore igitur magis laborandum. Atque certe postquam subjectum inquisitioni constitutum et terminatum sit atque a corpore rerum abscissum et inconfusum constiterit (in quo habemus nonnulla quæ utiliter præcipiamus,) ministratio ista ad memoriam tribus operis sive officiis constare videtur. Primo, docebimus qualia sint ea quæ circa subjectum datum sive propositum (discurrendo per historiam) inquiri debeant, quod est instar Topicæ. Secundo, quo ordine illa disponi oporteat, et in tabulas digeri. Neque tamen ullo modo speramus veram rei venam quæ ex analogia universi sit, jam a principio inveniri posse, ut eam partitio sequatur; sed tantum apparentem, ut res aliquo modo secetur in partes. Citius enim emerget veritas e falsitate quam e confusione, et facilius ratio corriget parti-

[illegible] Tertio itaque osten-
[illegible] inquisitio sit reinte-
[illegible] precedentes in chartas
[illegible] inquisitio sit repe-
[illegible] series vel sequelas
[illegible] et tantum proba-
[illegible] inquisitionis; siquidem mentem
[illegible] persequi et obtinere posse,
[illegible] diffidimus. Itaque minis-
[illegible] (ut diximus) doctrinis absol-
[illegible] de methodo contabulandi,
[illegible] inquisitionem. Superest minis-
[illegible] cui ministrationes duæ priores sub-
[illegible] Nullum enim per eas constituitur axioma,
[illegible] simplex cum historia ordinata; certo
[illegible] ministrationem primam, atque ita repræ-
[illegible] ut tanquam in potestate nostra
[illegible] ministratio ad rationem ea maxime probari
[illegible] rationem ad opus suum exequendum et
[illegible] optime juvabit. Opus autem rationis
[illegible] fine et usu geminum est. Aut enim
[illegible] *agere et efficere*, homini pro fine
[illegible] Itaque aut causæ expetitur cognitio et contem-
[illegible] aut effecti potestas et copia. Quamobrem dati
[illegible] in quovis subjecto causas nosse, in-
[illegible] Atque rursus, super datam
[illegible] effectum quodvis sive naturam (inter
[illegible]) imponere vel superinducere, intentio
[illegible] Atque hæ intentiones, acutius
[illegible] in idem coincidunt. Nam
[illegible] instar causæ est, in operatione
[illegible] enim per causas, operamur per
[illegible] universa quæ ad opera quæli-

[illegible]

bet requiruntur homini optato ad manum suppeterent, nil opus foret magnopere ista separatim tractare. Verum cum operatio humana in multo majores angustias compellatur quam scientia, propter individui multiplices necessitates et inopias; adeo ut ad partem operativam requiratur sæpius non tam sapientia universalis et libera de eo quod fieri potest, quam prudentia sagax et solers ad delectum eorum quæ præsto sunt; ista tractatu felicius disjungi consentaneum est. Quare et ministrationis eandem partitionem faciemus, ut aut parti contemplativæ aut activæ ministretur. Atque quod ad partem contemplativam attinet, ut verbo dicamus, in uno plane sunt omnia. Hoc ipsum non aliud est, quam ut verum constituatur axioma, sive idea[1] copulata; hæc enim est veritatis portio solida, cum simplex notio instar superficiei videri possit. Hoc autem axioma non elicitur aut efformatur, nisi per inductionis formam legitimam et propriam; quæ experientiam solvat et separet, atque per exclusiones et rejectiones debitas necessario concludat. Vulgaris autem inductio (a qua tamen principiorum ipsorum probationes petuntur) puerile quiddam est, et precario concludit, periculo ab instantia contradictoria exposita; adeo ut dialectici de ea nec serio cogitasse videantur, fastidientes et ad alia properantes. Illud interim manifestum est, quæ per inductionem cujusvis generis concluduntur, simul et inveniri et judicari, nec a principiis aut mediis pendere, sed mole stare sua, neque aliunde probari. Multo magis necesse est ea quæ ex vera in-

[1] Gruter's copy has *idem copulata;* obviously a misprint; which Blackbourn attempted to correct by silently substituting *copulatum;* a reading in which all subsequent editors have acquiesced, including M. Bouillet. I cannot doubt however that the error was in *idem*, and that the reading which I have introduced into the text is the true one.

ductionis forma excitantur axiomata, esse seipsis contenta, atque ipsis principiis, quæ vocantur, certiora et firmiora. Atque hoc genus inductionis illud est, quod interpretationis formulam appellare consuevimus. Itaque præ omnibus doctrinam de constitutione axiomatis et formula interpretandi diligenter et perspicue complectimur. Restant tamen quæ huic rei serviunt tria maximi omnino momenti, sine quorum explicatione inquisitionis istius præscriptum, licet potestate validum, tamen usu operosum censeri possit. Ea sunt, inquisitionis ipsius continuatio, variatio, et contractio; ut nihil in arte aut abruptum, aut incongruum, aut pro humanæ vitæ brevitate longum relinquatur. Docebimus itaque primo usum axiomatum (jam per formulam inventorum) ad alia axiomata inquirenda et excitanda, quæ superiora et magis generalia sint: ut per veros et nusquam intermissos gradus scalæ adscensoriæ ad unitatem naturæ perveniatur. In quo tamen adjiciemus modum eadem axiomata superiora per experientias primas examinandi et verificandi, ne rursus ad conjecturas et probabilia atque idola prolabamur. Atque hæc est ea doctrina, quam inquisitionis continuationem appellamus. Variatio autem inquisitionis sequitur naturam diversam, aut causarum quarum gratia inquisitio instituitur, aut rerum ipsarum sive subjectorum in quibus inquisitio versatur. Itaque missis causis finalibus, quæ naturalem philosophiam prorsus corruperunt, initia sumemus ab inquisitione variata sive accommodata formarum; quæ res pro desperata hucusque abjecta est, idque merito. Neque enim ulli obvenire possit tanta facultas aut felicitas, ut ex anticipationibus et dialecticis argumentationibus alicujus rei formam eruat. Sequentur inquisitiones materiarum et

efficientium. Cum autem efficientia et materias dicimus, non efficientia remota aut materias communes (qualia in disputationibus agitantur), sed efficientia propiora et materias præparatas intelligimus. Id ne sæpius subtilitate inutili repetatur, inventionem latentis processus subtexemus. Latentem autem processum appellamus seriem et ordinem mutationis; rem scilicet ex efficientis motu et materiæ fluxu conflatam. Quæ autem secundum subjecta fit inquisitionis variatio, ex duabus rerum conditionibus ortum habet; aut ex natura simplicis et compositi (alia enim accommodatur inquisitio ad res simplices, alia ad compositas et decompositas et perplexas), aut ex historiæ copia et inopia, quæ ad inquisitionem peragendam parari possit. Ubi enim historia abundat, expedita est ratio inquisitionis; ubi tenuis est, in arcto est labor, et multifaria industria et arte opus habet. Itaque per ista quæ jam dicta sunt tractata, variationem inquisitionis absolvi putamus. Restat inquisitionis contractio, ut non tantum in inviis via, sed et in viis compendium, et tanquam linea recta quæ per ambages et flexus secet, ex indiciis nostris innotescat. Hoc autem (veluti et omnis ratio compendiaria) maxime in rerum delectu consistit. Duas autem invenimus veluti rerum prærogativas, quæ ad inquisitionis compendia plurimum faciunt; Prærogativam Instantiæ, et Prærogativam Inquisiti. Itaque docebimus primo quales sint illæ instantiæ, sive experimenta, quæ ad illuminationem præ cæteris excellant, adeo ut paucæ idem quod aliæ plures præstent. Hoc enim et moli ipsius historiæ, et discurrendi laboribus parcit. Deinde etiam explicabimus qualia sint ea inquisita, a quibus interpretationem auspicari oporteat, utpote quæ prædisposita sequentibus facem quandam præferunt, aut ob

exquisitam certitudinem in se, aut ob naturam universalem, aut ob necessitatem ad probationes mechanicas. Atque hic ministrationi quæ ad contemplativam partem spectat, finem imponimus. Activam autem partem ac ejus ministrationem triplici doctrina claudemus, si prius duo monita ad aperiendas hominum mentes præmittamus. Horum primum est, in inquisitione ea quæ fit per formulam, inter contemplativam partem activam ipsam perpetuo intercurrere. Hoc enim fert rerum natura, ut propositiones et axiomata a magis generalibus per argumentationem dialecticam deducta et derivata, ad particularia et opera obscure admodum et incerto innuant. Quod autem ex particularibus axioma educitur, ad nova particularia tanquam correspondentia manifesto et constanti tramite ducat. Alterum hujusmodi est, ut meminerint homines, in inquisitione activa necesse esse rem per scalam descensoriam (cujus usum in contemplativa sustulimus) confici. Omnis enim operatio in individuis versatur, quæ infimo loco sunt. Itaque a generalibus per gradus ad ea descendendum est. Neque rursus fieri potest, ut per axiomata simplicia ad ea perveniatur; omne enim opus atque ejus ratio ex coitione axiomatum diversorum instituitur et designatur. Itaque hæc præfati, ad triplicem illam doctrinam activam veniemus; quarum prima proponit modum inquisitionis distinctum et proprium, ubi non jam causa aut axioma, sed operis alicujus effectio, ex intentione est atque inquisitioni subjicitur. Secunda ostendit modum conficiendi tabulas practicas generales, per quas omnigenæ operum designationes facilius et promptius deducantur. Tertia subjungit modum quendam inquirendi sive inveniendi opera, imperfectum certe, sed tamen non inutilem, quo ab experimento ad experi-

mentum procedatur absque constitutione axiomatis. Nam quemadmodum ab axiomate ad axioma, ita etiam ab experimento ad experimentum datur et aperitur quædam via ad inveniendum instabilis et lubrica, sed tamen non prorsus silentio prætermittenda. Jam igitur et practicam ministrationem quoque, quæ in distributione ultima posita est, absolvimus. Atque hæc est hujusce secundi libri aperta et brevis delineatio. Quibus explicatis, Thalamum nos Mentis Humanæ et Universi, pronuba divina bonitate, plane constituisse confidimus. Epithalamii autem votum sit, ut ex eo connubio auxilia humana, tanquam stirps heroum, quæ necessitates et miserias hominum aliqua ex parte debellent et doment, suscipiatur et deducatur. Sub finem tamen quædam de laborum consociatione et successione subjiciemus. Tunc enim demum homines vires suas noscent, cum non eadem infiniti, sed omissa alii præstabunt. Neque sane de futuris ætatibus spem abjecimus, quin exoriantur qui ista a tenuibus profecta initiis in majus provehant. Illud enim occurrit, hoc quod agitur, ob boni naturam eminentem, manifeste a Deo esse. In divinis autem operibus minima quæque principia eventum trahunt.[1]

REDARGUTIO PHILOSOPHIARUM.

Atque in redargutione ipsa philosophiarum quam paramus, nescimus fere quo nos vertamus, cum via quæ aliis in confutationibus patuit nobis interclusa sit.

[1] Here the Delineation ends, and the work itself begins, with the first part of the *Pars Destruens;* namely the *Redargutio Philosophiarum.* The Harleian MS. (which begins with the words *Dum hæc tractarem*, in page 57. and enables us to complete this fragment) bears that title, and this seems to be the proper place for the introduction of it; though there is no title here in the original, but only a fresh paragraph.

Nam et tot et tanta se ostendunt errorum agmina, ut ea non strictim sed confertim evertere et summovere necesse sit; et si propius accedere et cum singulis manum conserere velimus, id frustra fuerit; sublata disputationis lege, cum de principiis non consentiamus; et multo magis, quod ipsas probationum et demonstrationum formas et potestates rejiciamus. Quod si (id quod solum relinqui videtur) ea quæ nos asserimus a sensu ipso et experientia educere et excitare connitamur, rursus eodem revolvimur; et obliti eorum quæ de animorum præparatione dicta sunt, contrariam ingressi viam inveniamur; nam in res ipsas abrupte et directo incidamus, ad quas viam quandam aperiri et substerni, propter obfirmatas animorum præoccupationes et obsessiones, necesse esse decrevimus. Sed tamen propterea ipsi nos minime deseremus; sed aliquid comminisci et tentare quod proposito nostro consentaneum sit conabimur; tum signa quædam adducentes, ex quibus de philosophiis judicium fieri possit; tum interim inter ipsas philosophias, portenta errorum nonnulla, et mera animorum ludibria, ad earum authoritatem labefactandam notantes. Neque tamen nos fugit, fortius hujusmodi errorum æra[1] figi, quam ut eis per satyram derogetur; præsertim cum viris doctis non sit nova aut incognita ea confidentiæ et jactantiæ species, quæ opiniones abjicit, non frangit. Sed nec nos aliquid levius aut inferius quam pro rei quæ agitur majestate afferemus, neque ex hoc genere redargutionis prorsus fidem facere, sed tantum patientiam et æquanimitatem, idque in ingeniis tantum altioribus et firmioribus, conciliare speramus. Neque enim quispiam ex isto assiduo et perpetuo errorum contubernio ita se

[1] *aëra* in Gruter.

recipere potest, et ad nostra cum tanta benevolentia et animi magnitudine accedere, ut non cupiat habere interim quæ de veteribus et receptis cogitet et opinetur. Sane in tabellis non alia inscripseris, nisi priora deleveris; in mente ægre priora deleveris, nisi alia inscripseris.

Itaque huic desiderio subveniendum putavimus, atque hæc prorsus eo spectant (ut quod res est aperte eloquamur) ut volentes ducant, non ut nolentes trahant. Omnem violentiam (ut jam ab initio professi sumus) abesse volumus: atque quod Borgia facete de Caroli Octavi expeditione in Italiam dixit, Gallos venisse in manibus cretam tenentes, qua diversoria notarent, non arma, quibus perrumperent; similem quoque inventorum nostrorum et rationem et successum animo præcipimus; nimirum ut potius animos hominum capaces et idoneos seponere et subire possint, quam contra sentientibus molesta sint. Verum in hac parte de qua jam loquimur, quæ ad redargutionem philosophiarum pertinet, feliciter sane levati sumus, casu quodam opportuno et mirabili. Nam[1] dum hæc tractarem, intervenit amicus meus quidam ex Gallia rediens, quem cum salutassem, atque ego illum, ille me, de rebus nostris familiariter interrogassemus: Tu vero, inquit, vacuis tuis ab occupationibus civilibus spatiis,[2] aut saltem remittentibus negotiis, quid agis? Opportune, inquam; nam ne nihil[3] me agere existimes, meditor Instaura-

[1] Here begins the Harleian MS.: the title *Redargutio Philosophiarum* being inserted at the head of it, but in a comparatively modern hand. Whether it bore that title originally must remain doubtful, the cover (if it ever had any) being lost.

[2] The word *spatiis* is crossed out in the MS., and *intervallis* substituted in Bacon's hand. It is the only correction which Gruter's copy does not contain.

[3] *nil* in MS.

tionem Philosophiæ, quæ[1] nihil inanis aut abstracti habeat, quæque vitæ humanæ conditiones in melius provehat. Honestum profecto opus, inquit: et quos socios habes? Ego certe, inquam, in summa solitudine versor.[2] Duræ inquit, partes tuæ sunt; et statim addidit; Atque tamen scito hæc aliis curæ esse. Tum ego lætatus, Animam, inquam, reddidisti.[3] Ego enim hoc animo præceperam, fœtum meum veluti in eremo periturum.[4] Vis, inquit, ut tibi narrem quæ mihi in Gallia circa hujusmodi negotium evenerunt? Libentissime, inquam, atque insuper gratiam habebo. Tum retulit se Parisiis vocatum a quodam amico suo, atque introductum in consessum virorum, qualem, inquit, vel tu videre velles; nihil[5] in vita mihi accidit jucundius. Erant autem circiter quinquaginta viri, neque ex iis quisquam adolescens, sed omnes ætate provectiores; quique vultu ipso dignitatem cum probitate singuli præ se ferrent. Inter quos aiebat se cognovisse nonnullos honoribus perfunctos, atque alios ex senatu; etiam antistites sacrorum insignes, atque ex omni fere ordine eminentiore aliquos. Erant etiam quidam, ut aiebat, peregrini ex diversis nationibus. Atque cum[6] primo introiisset, invenisse[7] eos familiariter inter se colloquentes; sedebant tamen ordine sedilibus dispositis, ac veluti adventum alicujus expectantes. Neque ita multo post

[1] *ejusmodi quæ* in MS.

[2] *Ego certe, inquam, profecto nullos: quin nec quenquam habeo quocum familiariter de hujusmodi rebus colloqui possim, ut me saltem explicem et exacuam.* — MS.

[3] *Guttula, inquam, me aspersisti atque animam reddidisti.* — MS.

[4] *Ego enim anum quandam fatidicam non ita pridem conveni, quæ mihi nescio quid obmurmurans vaticinata est fœtum meum in solitudine periturum.* — MS.

[5] *nihil enim.* — MS.

[6] *cum ille.* — MS.

[7] *invenit.* — MS.

ingressum ad eos virum quendam,[1] aspectus (ut ei videbatur) admodum placidi et sereni; nisi quod oris compositio erat tanquam miserantis; cui cum omnes assurrexissent: Ille circumspiciens et subridens, nunquam, inquit, existimavi potuisse fieri, ut otium omnium vestrum, cum singulos recognosco, in unum atque idem tempus coinciderit; idque quomodo evenerit, satis mirari non possum. Cumque unus ex cœtu respondisset, eum ipsum hoc otium illis fecisse, cum quæ ab ipso[2] exspectarent illi ducerent omni negotio potiora: Atque (ut video) inquit, universa illa jactura ejus quod hic consumetur temporis, quo certe vos separati multis mortalibus profuissetis, ad meas rationes accedet. Quod si ita est, videndum profecto ne vos diutius morer; simul consedit, absque suggesto aut cathedra, sed ex æquo cum cæteris; atque hujusmodi quædam apud eum consessum verba fecit. Nam aiebat qui hæc narrabat, se illa tum excepisse ut potuit; licet cum apud se una cum illo amico suo, qui eum introduxerat, ea recognosceret, fateretur ea longe inferiora iis quæ tum dicta essent visa esse. Exemplum autem orationis,[3] quod circa se habebat, proferebat. Illud ita scriptum erat: Vos certe, filii, homines estis: hoc est, ut ego existimo, non animantes erecti, sed Divi mortales.[4] Deus, mundi conditor et vestrum, animas vobis donavit mundi ipsius capaces; nec tamen eo ipso satiandas. Itaque fidem vestram sibi seposuit et retinuit,[5] mundum sensui attribuit; neutra autem oracula clara esse voluit, sed in-

[1] *ingressus est ad eos vir quidam.* — MS.

[2] So MS. Gruter's copy has *illo.*

[3] *orationis, quam exceperat.* — MS.

[4] *homines estis et mortales; nec conditionis vestræ tantum pœniteat si naturæ vestræ satis memineritis.* — MS.

[5] *et retinuit* omitted in MS.

voluta; neque queri potestis si vos exerceat,[1] quandoquidem excellentiam rerum rependat.[2] Atque de rebus divinis optima de vobis spero; circa humana autem metuo vobis, ne diuturnus error vos usuceperit. Existimo enim hoc apud vos penitus credi, vos statu uti scientiarum florente et bono. Ego rursus moneo vos, ne eorum quæ habetis aut copiam aut utilitatem, quasi ad magnum aliquod fastigium evecti et votorum compotes aut laboribus perfuncti accipiatis. Idque sic considerate; si[3] omnem illam scriptorum varietatem qua scientiæ tument et luxuriantur excutiatis, et de eo quod afferunt scripta illa[4] interpelletis et stricte et presse examinetis, ubique reperietis ejusdem rei repetitiones infinitas; verbis, ordine, exemplis, atque illustratione, diversas; rerum summa et pondere ac vera potestate prælibatas ac demum fere[5] iteratas; ut in pompa paupertas sit, et in rebus jejunis fastidium. Atque si vobiscum familiariter loqui et jocari hac de re liceat, videtur doctrina vestra cœnæ illius[6] hospitis Chalcidensis simillima, qui cum interrogaretur unde tam varia venatio, respondit, illa omnia condimentis[7] ex mansueto sue esse facta. Neque enim negabitis universam istam copiam nil aliud esse quam portionem quandam philosophiæ Græcorum; eamque certe minime in saltu aut sylvis naturæ nutritam; sed in scholis et cellis, tanquam animal domesticum saginatum. Si enim[8] a Græcis iisque paucis abscedatur,[9] quid tandem habent vel Romani vel Arabes vel nostri, quod non ab Aristotelis,

[1] *ut vos exerceret.* — MS.
[2] *rependeret.* — MS.
[3] *in omnem.* — MS.
[4] *excutiatis et . . . scripta illa* omitted in MS.
[5] *ac plane* in MS.
[6] *illi* MS.
[7] *condimentis* omitted in MS.
[8] *Quod si.* — MS.
[9] *abscedatis.* — MS.

Platonis, Hippocratis, Galeni, Euclidis,[1] Ptolemæi inventis derivetur, aut in eadem recidat? Itaque videtis divitias vestras esse paucorum census; atque in sex fortasse hominum cerebellis spes et fortunas omnium sitas esse.[2] Neque vero idcirco Deus vobis animas rationales indidit, ut Authoris vestri partes[3] (fidem scilicet vestram quæ Deo et[4] divinis debetur) hominibus differretis: neque sensus informationem firmam et validam attribuit, ut paucorum hominum opera, sed ut ipsius Dei opera,[5] Cœlum et Terram, contemplaremini; laudes ejus[6] celebrantes, et hymnum conditori[7] vestro canentes, iis[8] etiam viris, si placet (nihil enim obstat), in chorum receptis.[9] Quinetiam ista ipsa doctrina, usu vestra, origine Græca, quæ tanta pompa incedit, quota pars fuit illa sapientiæ Græcorum? Ea enim varia fuit; varietas autem ut veritati non acquiescit, ita nec errorem figit; sed ad veritatem est instar iridis ad solem, quæ omnium imaginum est maxime infirma et quasi deperdita, sed tamen imago. Verum et hanc quoque varietatem nobis extinxit (Græcus et ipse) Aristoteles: credo, ut discipuli res gestas æquaret. Atque discipuli præconium (si recte memini) tale celebratur:

> Felix terrarum prædo, non utile mundo
> Editus exemplum, terras tot posse sub uno
> Esse viro.

An et magister, felix doctrinæ prædo? Acerbe illud,

[1] In the MS. *Euclidis* is inserted between the lines in Bacon's hand.
[2] *Itaque videtis in sex fortasse hominum cerebellis et animulis spes et fortunas vestras sitas esse.* — MS.
[3] *suas partes.* — MS.
[4] *Deo et* omitted in MS.
[5] *sua demum opera.* — MS.
[6] *suas* in MS.
[7] *authori.* — MS.
[8] *his.* — MS.
[9] *acceptis.* — MS. Here Gruter's copy ends.

sed quæ sequuntur optime. Nullo enim modo ille utilis rebus humanis, qui tot egregia ingenia, tot (inquam) libera capita in servitutem redegerit. Itaque, filii, de copia vestra audistis quam arcta, quam ad paucos redacta. Divitiæ enim vestræ sunt paucorum census.[1] De utilitate jam attendite. At quem tandem aditum ad mentes et sensus vestros, non dicam impetrabimus (vos enim benevoli), sed struemus aut machinabimur, res siquidem difficilis? Quo fomite, qua accensione lumen vobis innatum excitabimus, idque a præstigiis luminis adventitii et infusi liberabimus? Quomodo, inquam, nos vobis dabimus, ut vos vobis reddamus? Infinita præjudicia facta sunt, opiniones haustæ, receptæ, sparsæ. Theologi multa e philosophia ista sua fecerunt, et speculativam quandam ab utraque doctrina coagmentatam condiderunt. Viri civiles, qui ad existimationis suæ fructum pertinere putant ut docti habeantur, multa ubique ex eadem scriptis suis et orationibus inspergunt. Etiam voces, filii, et verba ex dictamine ejusdem philosophiæ, et secundum ejus præscripta et placita, apposite conficta sunt; adeo ut simul ac loqui didiceritis (felicem dicam an infelicem) hanc errorum Cabalam haurire et imbibere necesse fuerit. Neque hæc tantum consensu singulorum firmata, sed et institutis academiarum, collegiorum, ordinum, fere rerumpublicarum, veluti sancita est. Huic itaque jam subito renunciabitis? idne sumus vobis authores? Atqui ego, filii, hoc non postulo, neque hujusmodi philosophiæ vestræ fructus moror, aut eos vobis interdico, neque in solitudinem aliquam vos abripiam. Utimini philosophia quam habetis, disputa-

[1] This sentence is underlined in the MS. In Gruter's copy it is introduced before and would probably have been omitted here.

tiones vestras ex ejus uberibus alite, sermones ornate, graviores apud vulgus hominum hoc ipso nomine estote. Neque enim philosophia vera ad hæc multum utilis vobis erit: non præsto est, nec in transitu capitur, nec ex prænotionibus intellectui blanditur, non ad vulgi captum (nisi per utilitatem et opera) descendit. Servate itaque et illam alteram, et prout commodum vobis erit adhibete: atque aliter cum natura, aliter cum populo negotiamini. Nemo enim est qui plus multo quam alius quis intelligit, quin ad minus intelligentem tanquam personatus[1] sit, ut se exuat, alteri det. Verum illud vos familiariter pro more nostro moneo, Habete Laidem dummodo a Laide non habeamini.[2] Judicium sustinete; aliis vos date, non dedite; et vos melioribus servate. Atque videmur minus quiddam vobis imponere,[3] quod hæc quæ in manibus habetis usu vobis et honore manebunt; ideoque æquiore animo passuri estis, eadem de veritate et utilitate in dubium vocari. Verum etiamsi vos optime animati essetis, ut quæcunque hactenus didicistis aut credidistis, spretis opinionibus ac etiam rationibus vestris privatis, vel hoc ipso loco deposituri sitis, modo de veritate vobis constaret; attamen hac quoque ex parte hæremus; neque habemus fere quo nos vertamus, ut fidem vobis rei tam inopinatæ et novæ faciamus. Certe disputationis lex penitus sublata est, cum de principiis nobis vobiscum non conveniat. Etiam spes ejusdem præcisa est, quia de demonstrationibus quæ nunc in usu sunt dubitatio

[1] Compare *De Int. Nat. Sententiæ*, XII.: *Privata Negotia* personatus *administret, rerum tamen provisus subvenerans.*

[2] Diog. Laërt. in Aristippo. — *R. L. E.*

[3] *Atque respirare mihi nonnihil videmini*, was the original reading of the MS.

injecta est, atque accusatio suscepta. Atque hoc animorum statu veritas ipsa vobis non tuto committitur. Itaque intellectus vester præparandus antequam docendus, animi sanandi antequam exercendi sunt, area denique purganda antequam inædificanda: atque ad hunc finem hoc tempore convenistis. Qua igitur industria aut commoditate hoc negotium discutiemus aut agemus? Non desperandum. Inest profecto, filii, animæ humanæ, utcunque occupatæ et obsessæ, aliqua pars intellectus pura et veritatis hospita; estque ad eam aliqua molli clivo orbita deducens. Agite, filii, vos et ego viros doctos, si quid in hoc genere sumus, exuamus; et faciamus nos tanquam aliquos e plebe, et omissis rebus ipsis ex signis quibusdam externis conjecturas capiamus. Hæc enim saltem nobis cum hominibus communia sunt. Doctrina vestra, ut dictum est, fluxit a Græcis. Qualis natio? Nil mihi rei cum convitio est, filii; itaque quæ de ea dicta sunt ab aliis, nec repetam nec imitabor. Tantum dico eam nationem fuisse semper ingenio præproperam, more professoriam; quæ duo sapientiæ et veritati sunt inimicissima. Nec præterire fas est verba sacerdotis Ægyptii, præsertim, ad virum e Græcia excellentem prolata, ab authore etiam nobili e Græcia relata. Is sacerdos certe verus vates fuit, cum diceret, Vos Græci semper pueri. Annon bene divinatum est? Verissime certe, Græcos pueros æternos esse; idque non tantum in historia et rerum memoria, sed multo magis in rerum contemplatione. Quidni enim sit instar pueritiæ ea philosophia, quæ garrire et causari noverit, generare et procreare non possit? Disputationibus inepta operibus inanis? Mementote ergo (ut ait propheta) rupis ex qua excisi estis, et de natione

cujus authoritatem sequimini, quod Græca sit, interdum cogitate. Sequitur temporis nota, qua philosophia ista vestra nata est et prodiit. Ætas erat, filii, cum illa condita fuit, fabulis vicina, historiæ egena, peregrinationibus et notitia orbis parum informata aut illustrata, quæque nec antiquitatis venerationem nec temporum recentium copiam habebat, sed utraque dignitate et prærogativa carebat. Etenim antiquis temporibus credere licet fuisse divinos viros, qui altiora quam pro hominum communi conditione saperent. Nostram autem ætatem fateri necesse est, præ illa de qua loquimur, (ut taceam ingeniorum et meditationum fructus et labores) etiam duorum fere mille annorum eventis et experientia, et duarum tertiarum orbis notitia auctam esse. Itaque videte quam anguste habitaverint vel potius conclusa fuerint illius ætatis ingenia, si rem vel per tempora vel per regiones computetis. Neque enim mille annorum historiam, quæ digna historiæ nomine sit, habebant; sed fabulas et somnia. Regionum vero tractuumque mundi quotam partem noverant? Cum omnes hyperboreos Scythas, omnes occidentales Celtas, indistincte appellarent; nil in Africa ultra citimam Æthiopiæ partem, nil in Asia ultra Gangem, multo minus novi orbis provincias, ne per auditum sane aut fama nossent; imo et plurima climata et zonas, quibus populi infiniti spirant et degunt, tanquam inhabitabiles ab illis pronuntiatæ sint: quinetiam peregrinationes Democriti, Platonis, Pythagoræ, non longinquæ profecto, sed potius suburbanæ, ut magnum aliquid celebrantur. Atque experientia, filii, ut aqua, quo largior est eo minus corrumpitur. Nostris autem temporibus (ut scitis) oceanus sinus laxavit, et novi orbes patuere, et veteris orbis extrema undique

innotescunt, idque distincte ac proprie. Itaque ex ætatis et temporis natura, veluti ex nativitate et genitura philosophiæ vestræ, nil magni de ea Chaldæi prædixerint. De hominibus videamus. Qua in re optimo fato hoc fit (neque id artificio aliquo nostro cautum est, sed ipsa res hoc non solum patitur, verum etiam postulat), ut et illis honor servetur, et nos modestiam nostram tueri et retinere possimus, et tamen fidem liberare. Nos enim, filii, nec invidiæ nec jactantiæ nobis conscii sumus, nec de ingenii palma nec de placitorum regno contendimus; longe alia nostra ratio est et finis, hocque mox aperietur. Itaque antiquorum ingeniis, excellentiæ, facultati, nihil detrahimus; sed generi ipsi, viæ, instituto, authoritati, placitis, necessario derogamus. Immensum enim est quantum scientiarum progressum deprimant; atque opinio copiæ inter maximas causas inopiæ reperitur. Atque duo sunt viri, filii, quorum placita ex libris eorum propriis haurire licet: Plato et Aristoteles: utinam illud et reliquorum nonnullis contigisset. Sed Aristoteles, Othomannorum more, regnare se non potuisse existimavit, nisi fratres trucidasset. Idque ei, non statim sane sed postea, ex voto nimis feliciter successit. De his itaque duobus pauca dicere instituimus. Xenophontem autem tertium non adjungimus, suavem scriptorem et virum excellentem. Verum cum illis qui philosophiam tanquam ingenii peregrinationem amœnam et jucundam, non tanquam provinciam laboriosam et solicitam, susceperunt, nobis non multum rei est. Itaque hos duos viros, Platonem et Aristotelem, si quis inter maxima mortalium ingenia non numeret, aut minus perspicit aut minus æquus est. Ingenia certe illorum capacia, acuta, sublimia. Sed tamen videndum primo, cujus

generis philosophantium censeri possint. Invenio enim tria genera apud Græcos eorum qui philosophiæ cultores habiti sint. Primum erat sophistarum, qui per plurimas civitates instituta profectione, et per singulas mansitantes, adolescentes, recepta mercede, sapientia imbuere professi sunt; quales fuere Gorgias, Protagoras, Hippias, quos Plato ubique exagitat, et fere in comœdiæ morem deridendos propinat. Neque enim hi rhetores tantum erant, aut orationum conscriptores, sed universalem rerum notitiam sibi arrogabant. Secundum erat eorum qui majore fastu et opinione, locis certis et sedibus fixis, scholas aperiebant, atque placita et sectam condentes aut excipientes, auditores, sectatores, successores insuper habebant. Ex quo genere erant Plato, Aristoteles, Zeno, Epicurus. Nam Pythagoras etiam auditores traxit, et sectam constituit; sed traditionum potius quam disputationum plenam, et superstitioni quam philosophiæ propiorem. Tertium autem genus erant eorum, qui remoto strepitu et pompa professoria, serio veritatis inquisitioni et rerum contemplationi dediti, et (tanquam Endymion) solitarii et quasi sopiti, sibi philosophabantur; aut adhibitis paucis (quibus idem amor erat) in colloquiorum suavitatem, destinata perficiebant; neque Galateæ more, cujus lusus in undis, disputationum procellis se oblectabant. Atque tales fuere Empedocles, Heraclitus, Democritus, Anaxagoras, Parmenides. Neque enim reperietis hos scholas aperuisse, sed tandem speculationes et inventa sua in scripta redegisse, et posteris transmisisse. Nunc autem videtis certe, filii, quæ res agatur. Ego enim duo prima genera (utcunque se invicem abnegent et proscindant) tamen natura rei ipsius connexa esse statuo. Itaque non hæsitabo apud vos dicere, me lo-

cum Platoni et Aristoteli tribuere inter Sophistas: sed tanquam ordinis emendati et reformati. Eandem enim rem prorsus video. Aberat fortasse loci mutatio et circumcursatio, et mercedis indignitas, et inepta ostentatio; atque lucet in illis certe quiddam solennius et nobilius; sed aderant schola, auditor, secta.[1] Itaque genus ipsum profecto cernitis. Jam vero de viris ipsis aliquid separatim dicamus; institutum servantes, ut missis rebus ex signis conjiciamus. Itaque ab Aristotele exorsi, memoriam vestram, filii, testamur, si in physicis ejus et metaphysicis non sæpius dialecticæ quam naturæ voces audiatis. Quid enim solidi ab eo sperari possit, qui mundum tanquam e categoriis effecerit? qui negotium materiæ et vacui, et raritatis et densitatis, per distinctionem Actus et Potentiæ transegerit? qui animæ genus non multo melius quam ex vocibus secundæ intentionis tribuerit? Verum hæc ad res ipsas penetrant. Itaque ab hujusmodi sermone absistendum. Nam cum confutationem justam instituere immemoris plane sit, ita et opiniones tanti hominis per satyram perstringere superbum foret. Signa autem in illo non bona, quod ingenium incitatum et se proripiens, nec alienæ cogitationis nec propriæ fere patiens; quod quæstionum artifex,[2] quod contradictionibus continuus, quod antiquitati infestus et insultans, quod quæsita obscuritas est; alia plurima, quæ omnia magisterium sapiunt, non inquisitionem

[1] The words *nobis autem pro desperata habetur res, cum inquisitio veritatis transit in institutionem aut defensionem sectæ*, which followed in the MS., have a line drawn through them.

[2] Originally *Signa autem illa non bona quod ubique inanes quæstiones subdit, dein solvit; Quod in causarum explicatione, præsertim earum quæ ad particulares operationes spectant, aut propria subtilitate attonitus hæret et ambigit, aut partem rei attingit et statim se abripit: Quod contradictionibus*, &c.

veritatis.[1] Quod si quis ad hæc: censuram rem proclivem fortasse esse; illud interim constare, post Aristotelis opera edita, pleraque antiquorum veluti deserta exolevisse; apud tempora autem quæ sequuta sunt, nil melius inventum esse; magnum itaque virum Aristotelem, qui utrumque tempus ad se traxerit; atque verisimile esse, philosophiam in eo ipso tanquam sedes fixas posuisse, ut nihil restet nisi ut conservetur et ornetur: — Ego, filii, cogitationem hanc esse existimo hominis vel imperiti, vel partibus infecti, vel desidis. Est enim (ut dicit scriptura) desidia quædam, quæ sibi prudens videtur et septemplici rationum pondere gravior. Atque proculdubio (si verum omnino dicendum est) ista desidia hujus opinionis invenietur pars vel maxima; dum humanæ naturæ ingenita superbia, vitiis propriis non solum ignoscens verum etiam cultum quendam prophanum attribuens, laborum et inquirendi et experiendi fugam pro ea quæ prudentiæ comes sit diffidentia veneretur; neque ita multo post, socordia singulorum judicium et authoritatem universorum repræsentet et effingat. Nos vero primo illud interrogamus, an ob illud vir magnus Aristoteles, quod utrumque tempus traxerit? Certe magnus: Itane? At non major quam impostorum maximus. Imposturæ enim, atque adeo Principis Imposturæ Antichristi, hæc prærogativa singularis est. Veni (inquit veritas ipsa) in nomine patris mei, nec recipitis me: si quis venerit nomine suo, eum recipietis. Audistisne filii? sensu non proprio certe, sed pio et vero, qui in nomine paternitatis aut antiquitatis venerit non receptum iri; qui autem priora prosternendo, destruendo, authoritatem sibi usurpaverit et

[1] Originally, *et conditorem sectæ, non sanam et sinceram inquisitionem veritatis.*

in nomine proprio venerit, eum homines sequi. Atque si quis unquam in philosophia in nomine proprio venit, is est Aristoteles, per omnia sibi author, quique antiquitatem ita despexit, ut neminem ex antiquis vel nominare fere dignetur, nisi ad confutationem et opprobrium. Quin et disertis verbis dicere non erubescit (bene ominatus certe etiam in maledicto), verisimile esse majores nostros ex terra aliqua aut limo procreatos fuisse, ut ex opinionibus et institutis eorum stupidis et vere terreis conjicere licet. Neque tamen illud verum est, antiquorum philosophorum opera, postquam Aristoteles de iis ex authoritate propria triumphasset, statim extincta fuisse. Videmus enim qualis fuerit opinio de prudentia Democriti post Cæsarum tempora,

> Cujus prudentia monstrat,
> Magnos posse viros, et magna exempla daturos,
> Vervecum in patria, crassoque sub aëre nasci.[1]

Atque satis constat, sub tempora excultiora imperii Romani plurimos antiquorum Græcorum libros incolumes mansisse. Neque enim tantum potuisset Aristoteles (licet voluntas ei non defuerit) ut ea deleret, nisi Attila et Gensericus et Gothi ei in hac re adjutores fuissent. Tum enim postquam doctrina humana naufragium perpessa esset, tabula ista Aristotelicæ philosophiæ, tanquam materiæ alicujus levioris et minus solidæ, servata est, et extinctis æmulis recepta. At quod de consensu homines sibi fingunt, id et infidum et infirmum est. An vos, filii, temporis partus habetis numeratos et descriptos in fastis, eos inquam qui perierunt, latuerunt, aut aliis orbis partibus innotuerunt? An et abortus qui nunquam in lucem editi sunt? Itaque desinant homines angustias suas mundo et sæculis attribuere et imponere. Quid

[1] Juv. x. 48.

si de suffragiis ipsis litem moveamus, et negemus verum et legitimum consensum esse, cum homines addicti credunt, non persuasi judicant? Transierunt, filii, ab ignorantia in præjudicium: hæc demum est illa coitio potius quam consensus. Postremo, si de isto consensu non diffiteamur, sed eum ipsum ut suspectum rejiciamus, an nos inter morbum istum animorum grassantem et epidemicum sanitatis pœnitebit? Pessimum certe, filii, omnium augurium est de consensu in rebus intellectualibus; exceptis divinis,[1] cum veritas descendit cœlitus. Nihil enim multis placet, nisi aut imaginationem feriat, ut superstitio, aut notiones vulgares, ut doctrina sophistarum: tantumque consensus iste a vera et solida authoritate abest, ut etiam violentam præsumptionem inducat in contrarium. Optime enim Græcus ille, Quid peccavi? cum complauderent. Quod si is esset vir qui putatur esse Aristoteles, tamen nullo modo vobis author sim, ut unius hominis cogitata et placita instar oraculi recipiatis. Quæ enim, filii, est ista voluntaria servitus? tantone auditoribus monachi illius ethnici deteriores estis, ut illi suum Ipse dixit post septennium deponerent, vos illud post annos bis mille retineatis? Atque nec istum ipsum præclarum authorem habuissetis, si antiquitatis studium valuisset: et tamen eadem in illum lege et conditione uti veremini. Quin, si me audietis, dictaturam istam, non modo huic homini sed et cuivis mortalium qui sunt, qui erunt, in perpetuum negabitis; atque homines in recte inventis sequemini, ut videntes lucem, non in omnibus promiscue, ut cæci ducem. Neque certe vos virium pœniteat, si experiamini: neque enim Aristotele in singulis, licet

[1] In the corresponding passage in the *Novum Organum* (i. § 77.) he adds *et politicis, ubi suffragiorum jus est.*

forte in omnibus, inferiores estis. Atque quod caput rei est, una certe re illum longe superatis, exemplis videlicet et experimentis et monitis temporis. Nam ut ille (quod narrant) librum confecerit in quo ducentarum quinquaginta quinque civitatum leges et instituta collegerit,[1] tamen non dubito quin unius reipublicæ Romanæ mores et exempla plus ad prudentiam et militarem et civilem contulerint quam omnia illa. Similia etiam et in naturali philosophia evenerunt. Itane vero animati estis, ut non tantum dotes vestras proprias, sed etiam temporis dona projiciatis? Itaque vindicate vos tandem, et vos rebus addite, neque accessio unius hominis estote. De Platone vero ea nostra sententia est; illum, licet ad rempublicam non accessisset sed a rebus civilibus administrandis quodammodo refugisset propter temporum perturbationes, tamen natura et inclinatione omnino ad res civiles propensum, vires eo præcipue intendisse; neque de philosophia naturali admodum solicitum fuisse, nisi quatenus ad philosophi nomen et celebritatem tuendam, et ad majestatem quandam moralibus et civilibus doctrinis addendam et aspergendam sufficeret. Ex quo fit, ut quæ de natura scripsit nil firmitudinis habeant. Quinetiam naturam theologia, non minus quam Aristoteles dialectica, infecit et corrupit. Optima autem in eo signa (si cætera consensissent), quod et formarum cognitionem ambiret, et inductione per omnia, non tantum ad principia sed etiam ad medias propositiones uteretur: licet et hæc ipsa duo vere divina, et ob quæ nomen divini non dico tulit sed meruit,[2] corruperit et inutilia reddiderit, dum

[1] His Republic. See the Life of Aristotle ascribed to Ammonius. Diog. Laertius says 158. V. § 27. — *R. L. E.*

[2] The words *duo — meruit* are inserted between the lines, in Bacon's hand; also the words *et inutilia reddiderit.*

et formas abstractas prensaret, et inductionis materiam tantum ex rebus obviis et vulgaribus desumeret; quod hujusmodi scilicet exempla (quia notiora) disputationibus potius convenirent. Itaque cum ei diligens naturalium rerum contemplatio et observatio deesset, quæ unica philosophiæ materia est, nil mirum si nec ingenium altum nec modus inquisitionis felix magnopere profecerint. Verum nos ex signorum consideratione nescio quo modo in res ipsas prolabimur: non enim facile separari possunt, neque ea ingrata vobis auditu fuisse arbitramur. Quinetiam fortasse et illud insuper scire vultis, quid de reliquis illis sentiamus, qui alienis, non propriis, scriptis nobis noti sunt; Pythagora, Empedocle, Heraclito, Anaxagora, Democrito, Parmenide, aliis. Atque hac de re, filii, nil reticebimus, sed animi nostri sensum integrum et sincerum vobis aperiemus. Scitote itaque, nos summa cum diligentia et cura omnes vel tenuissimas auras circa horum virorum opiniones et placita captasse: ut quicquid de illis, vel dum ab Aristotele confutantur, vel dum a Platone et Cicerone citantur, vel in Plutarchi fasciculo, vel in Laërtii vitis, vel in Lucretii poemate, vel in aliquibus fragmentis, vel in quavis alia sparsa memoria et mentione, inveniri possit, evolverimus; neque cursim aut contemptim, sed cum fide et deliberatione examinaverimus. Atque dubium profecto non est, quin si opiniones eorum, quas nunc per internuntios quosdam minime fidos solummodo habemus, in propriis extarent operibus, ut eas ex ipsis fontibus haurire liceret, majorem firmitudinem habituræ fuissent; cum theoriarum vires in apta et se mutuo sustinente partium harmonia, et quadam in orbem demonstratione consistant, ideoque per partes traditæ infirmæ sint. Neque negamus nos reperire, inter

placita tam varia, haud pauca in contemplatione naturæ et causarum assignatione non indiligenter notata. Alios autem in aliis (ut fere fieri solet) constat feliciores fuisse. Quod si cum Aristotele conferantur, plane censemus fuisse ex iis nonnullos, qui in multis Aristotele longe et acutius et altius in naturam penetraverint; quod fieri necesse fuit, cum experientiæ cultores magis religiosi fuerint, præsertim Democritus, qui ob naturæ peritiam etiam magus habitus est. Veruntamen nobis necesse est, si simpliciter et absque persona vobiscum agere stat decretum, nomina ista magna brevi admodum sententia transmittere: esse nimirum hujusmodi philosophorum placita ac theorias veluti diversarum fabularum in theatro argumenta, in quandam veri similitudinem, alia elegantius, alia negligentius aut crassius conficta; atque habere, quod fabularum proprium est, ut veris interdum narrationibus concinniora et commodiora videantur, et qualia quis libentius crederet. Sane cum isti famæ et opinioni, tanquam scenæ, minus servirent quam Aristoteles et Plato et reliqui e scholis, puriores fuere ab ostentatione et impostura, atque eo nomine saniores; cætera similes erant. Una enim quasi navis philosophiæ Græcorum videtur, atque errores diversi, causæ errandi communes. Quinetiam nobis minime dubium est, si penes populum et civitates liberas res mansissent,[1] fieri non potuisse ut humani ingenii peregrinationes popularibus auris velificantes, utcunque inter tam numerosa et varia theoriarum commenta se sistere aut continere potuissent. Quemadmodum enim in astro-

[1] Originally, *et nisi tempora sequentia et in Græcia et alibi a populi potentia ad monarchias et ad imperia magis unita et ordinata inclinassent, fieri non potuisse ut humani ingenii peregrinationes et errores, utcunque inter tantam theoriarum varietatem se sisterent aut finirent, sed ut aliæ multæ proculdubio fuissent novarum sectarum emanationes.*

nomicis, et iis quibus terram rotari placet et iis qui veterem[1] constructionem tenuerunt phænomenorum in cœlis patrocinia æqua sunt; quin et tabularum calculi utrisque respondent: eodem modo ac multo etiam facilius est in naturali philosophia complures theorias excogitare, inter se multum differentes, sed tamen singulas sibi constantes, et experientiam et præsertim instantias vulgares, quæ in quæstionibus philosophicis (ut nunc fit) judicia exercere solent, in diversum trahentes, et pro testibus citantes. Neque enim defuerunt etiam nostra ætate, in nostris inquam frigidis præcordiis atque tempore quo res religionis ingenia consumpserunt,[2] qui novas philosophiæ naturalis fabricas meditati sunt. Nam Telesius ex Consentia scenam conscendit et novam fabulam egit, argumento profecto magis probabilem quam plausu celebrem. Et Gilbertus ex Anglia, cum naturam magnetis laboriosissime et magna inquisitionis firmitudine et constantia, necnon experimentorum magno comitatu et fere agmine, perscrutatus esset, statim imminebat et ipse novæ philosophiæ condendæ; nec Xenophanis nomen in Xenomanem per ludibrium versum expavit, in cujus sententiam inclinabat. Quin et Fracastorius, licet sectam non condiderit, tamen libertate judicii honeste usus est. Eadem ausus est Cardanus, sed levior.[3] Atque existimo, filii, vos ad istam quam ex nobis auditis tam

[1] *per veterem* in the MS. But I think the *per* belonged to the sentence as originally written, and was meant to be struck out. The words for which *veterem constructionem tenuerunt* are substituted are too effectually obliterated to be read. But the two first are *eccentricos et epicyclos;* and the sentence probably stood originally as in the corresponding passage of the *Cogitata et Visa — qui per eccentricos et epicyclos motus expediunt.*

[2] This clause is added between the lines in Bacon's hand.

[3] These two sentences are added in the margin in Bacon's own hand; as are also the words *in Xenomanem per* in the last sentence.

latam et generalem opinionum et authorum rejectionem obstupescere. Licet enim de nobis bene existimetis, tamen vereri videmini ut invidiam hujusce rei nobiscum una sustinere possitis. Quin et ipsi (credo) miramini et animi pendetis, quorsum res hæc evasura sit, et quam tandem conditionem vobis afferamus. Itaque diutius suspensos vos non tenebimus : atque simul et vos admiratione et nos invidia, ut speramus, nisi admodum iniqua fuerit, exolvemus. Atque meministis profecto etiam ab initio nos tale quiddam significasse : antiquis non certe authoritatem et fidem (id enim pernitiosum), sed honorem ac reverentiam intacta et imminuta fore ; tametsi possemus pro jure nostro, neque eo ipso alio quam omnium, si quid apud eos non recte inventum aut positum sit, id reprehendere aut notare. Sed res ipsa hoc non postulat ; fato quodam, ut arbitramur, ad invidiam et contradictionem [1] extinguendam et depellendam meliore. Audite itaque, filii, quæ jam dicemus. Nos, si profiteamur nos meliora afferre quam antiqui, eandem quam antiqui viam ingressos, nulla verborum arte efficere possimus quin inducatur quædam ingenii vel excellentiæ vel facultatis comparatio sive contentio ; non ea quidem illicita aut nova ; sed impar ob virium nostrarum modum, quem eum esse satis sentimus ut non solum antiquis sed et vivis cedat. Cum autem (ut simpliciter apud vos loquamur) claudus in via (quod dici solet) cursorem extra viam antevertat, commutata ratio est. Atque [2] de via (mementote) non de viribus quæstio oritur ; nosque Indicis non Judicis partes sustinemus. Itaque aperte, valejusso omni fuco et arti-

[1] The words *et contradictionem* are an interlineation.
[2] *nam* originally. *Atque* substituted in Bacon's hand.

ficio, fatemur nos in hac opinione esse, omnia omnium ætatum ingenia si in unum coierint, eo quo nunc res geritur modo, hoc est (ut clare loquamur) ex meditatione et argumentatione, in scientiis magnos processus facere non posse. Quin neque hic finis; sed addimus insuper, quanto quis ingenio plus valet, eundem si naturæ lucem, id est historiam et rerum particularium evidentiam, intempestive deserat, tanto in obscuriores et magis perplexos phantasiarum recessus et quasi specus se detrudere et involvere. Annon forte animadvertistis, filii, quanta ingeniorum et acumina et robora apud philosophos scholasticos, otio et meditationibus luxuriantes et ob tenebras ipsas in quibus enutriti erant feroces, quales nobis telas aranearum pepererint, textura et subtilitate fili mirabiles, usus et commodi expertes? Etiam illud simul affirmamus; nostram quam ad artes adducimus rationem et inquisitionis formam, talem esse quæ hominum ingenia et facultates, ut hæreditates Spartanas, fere æquet. Nam quemadmodum ad hoc ut linea recta aut circulus perfectus describatur, plurimum est in manus ac visus facultate, si per constantiam manus et oculorum judicium tantum res tentetur; sin per regulam admotam aut circinum circumductum, non item; eadem ratione et in contemplatione rerum quæ mentis viribus solum incumbit, homo homini præstat vel maxime; in ea autem quam nos adhibemus, non multo major in hominum intellectu eminet inæqualitas quam in sensu inesse solet. Quin et ab ingeniorum acumine et agilitate (ut dictum est), dum suo motu feruntur, periculum metuimus; atque in eo toti sumus, ut hominum ingeniis non plumas aut alas, sed plumbum et pondera addamus. Nullo enim modo videntur homines adhuc

mentem humanam tam lævam et male compositam esse, ut primo diffidat et paulo post se contemnat; atque primo incredibile videatur aliquid tale inveniri posse; postquam autem inventum sit, rursus in credibile videatur id homines tam diu fugere potuisse. Sed ut quod res est proferamus, huic rei de qua nunc agimus impedimento fuit non tam rei obscuritas aut difficultas, quam superbia humana, cui natura ipsa magna ex parte eaque potiore sordescit, quæque homines eo dementiæ provehit, ut spiritus proprios, non spiritum naturæ consulant; ac si artes facerent, non invenirent. Atque, filii, inter istam vestram tanquam per statuas antiquorum deambulationem, fieri potest ut aliquam partem porticus notaveritis velo esse discretam. Ea sunt penetralia antiquitatis ante doctrinam Græcorum. Sed quid me vocatis ad ea tempora, quorum et res et rerum vestigia aufugerunt? Annon antiquitas illa instar famæ est, quæ caput inter nubila condit et fabulas narrat? facta et infecta simul canens? Atque satis scio, si minus sincera fide agere vellem, non difficile foret hominibus persuadere, apud antiquos sapientes diu ante Græcorum tempora, scientias et philosophiam majore virtute licet majore etiam fortasse silentio floruisse: ideoque[1] solennius mihi foret, ea quæ jam afferuntur ad illa referre, ut novi homines solent, qui nobilitatem alicujus veteris prosapiæ per genealogiarum rumores et conjecturas sibi affingunt. Verum nobis stat sententia, rerum evidentia fretis, omnem impostaræ conditionem, quantumvis sit licet bella et commoda, recusare. Itaque judicium nostrum de illis sæculis non interponimus; illud obiter dicimus, licet poetarum fabulæ versatilis materiæ sint, tamen nos non

[1] *idque* in MS., but compare *Cog. et Visa* (p. 121.): *Atque ideo solennius fore*, &c.

multum arcani aut mysterii hujusmodi narrationibus subesse haud cunctanter pronuntiassemus, si ab iis inventæ a quibus traditæ sunt; quod nos secus esse existimamus: pleræque enim traduntur tanquam prius creditæ et cognitæ, non tanquam novæ ac tunc primo oblatæ: quæ res earum existimationem apud nos auxit, ac si essent reliquiæ quædam sacræ temporum meliorum. Verum utcunque ea res se habet, non plus interesse putamus (ad id quod agitur) utrum quæ jam proponentur aut illis fortasse majora antiquis etiam innotuerint, quam hominibus curæ esse debeat utrum novus orbis fuerit insula illa Atlantis, et veteri mundo cognita, an nunc primum reperta; rerum enim inventio a naturæ luce petenda, non a vetustatis tenebris repetenda est. Jam vero (filii) etiam sponte, non fortasse interpellati ab expectatione vestra, de philosophia Chimistarum opinionem subjungemus. Etenim illa vestra philosophia, disputationibus potens, operibus invalida, artis chimicæ nonnullam existimationem apud quosdam peperit. Atque sane quod ad practicam Chimistarum attinet, fabulam illam in eam competere existimamus de sene qui filiis suis aurum in vinea defossum (nec se satis scire quo loco) legaverit: unde illos protinus ad vineam fodiendam incubuisse; atque auri quidem nihil repertum, sed vindemiam ea cultura factam fuisse uberiorem. Simili modo et chimiæ filii, dum aurum (sive vere sive secus) in naturæ arvo abditum et quasi defossum laboriose eruere conantur, multa moliendo et tentando, magno proventui hominibus et utilitati fuere, et compluribus inventis non contemnendis vitam et res humanas donavere. Veruntamen speculativam eorum rem levem et minus sanam esse judicamus. Nam ut ille adolescentulus delicatus

cum scalmum in littore reperisset navem ædificare concupivit, ita et hi, arti suæ indulgentes, ex paucis fornacis experimentis philosophiam condere aggressi sunt. Atque hoc genus theoriarum et sæpius et manifestius vanitatis coarguitur, quam illud alterum, quod certe magis sobrium et magis tectum est. Nam philosophia vulgaris, omnia percurrens et nonnihil fere de singulis degustans, se apud maximam hominum partem optime tuetur. Qui autem ex paucis quibus ipse maxime insuevit reliqua comminiscitur, is et re ipsa errat magis, et apud alios levior est. Atque ex hoc genere philosophiam chimicam esse censemus. Certe illa opinionis fabrica quæ eorum philosophiæ basis est, esse nimirum quatuor rerum matrices sive elementa in quibus semina rerum sive species fœtus suos absolvunt, atque producta eorum quadriformia esse, pro differentia scilicet cujusque elementi; adeo ut in cœlo, aëre, aqua, terra nulla species inveniatur quæ non habeat in tribus reliquis conjugatum aliquod et quasi parallelum (nam hominem etiam pantomimum effecerunt, ex omnibus conflatum, abusi elegantia vocabuli *microcosmi*); hoc, inquam, commentum neminem judicio sedatum post se traxerit: quin et existimamus, huic phantasticæ[1] rerum naturalium phalangi peritum naturæ contemplatorem vix inter somnia sua locum daturum. Verum illud non incommode accidit ad præcavendum, quod hæc philosophia (ut cœpimus dicere) erroris genere veluti antistropha vulgari philosophiæ sit; vulgaris enim philosophia ad materiam inventionis parum ex multis, hæc multum e paucis decerpit. Nos tamen, filii, libenter Paracelsum (hominem, ut conjicere licet, satis vocalem[2]) nobis

[1] *phantastico* in MS.

[2] There are no marks of parenthesis here in the MS.; nor even a comma

præconem exoptemus, ut illud *lumen naturæ*, quod toties inculcat, celebret et proclamet. Atque mentio Chimistarum nos admonet, ut aliquid etiam de Magia naturali, ea quæ nunc hoc vocabulum solenne et fere sacrum inquinavit, dicamus: ea enim inter philosophos chimicos in honore esse consuevit. Quæ nobis in hujusmodi sermone inferior videtur quam ut condemnetur: sed levitate ipsa effugiat. Quid enim illa ad nos, cujus dogmata plane phantasia et superstitio, opera præstigiæ et impostura? Nam inter innumera falsa si quid ad effectum perducitur, hujusmodi semper est, ut sit ad novitatem et admirationem conficta, non ad usum aut accommodata aut destinata. Etenim evenit fere semper de magicis experimentis quod poeta lascivus ludit, *Pars minima est ipsa puella sui*. Quemadmodum autem philosophiæ proprium est, efficere ut omnia minus quam sint admiranda videantur propter demonstrationes; ita et imposturæ non minus proprium est, ut omnia magis quam sunt admiranda videantur propter ostentationem et falsum apparatum. Atque ista tamen vanitas nescio quomodo contemnitur et recipitur; unde enim satyrion ad venerem, pulmones vulpis ad phthisim,[1] nisi ex hac officina? Verum nimis multa de nugis; nimis sane, si, ut ineptæ, ita innoxiæ essent. Resumamus orationis filum, et philosophiam quam in manibus habemus ex signis excutiamus; ista enim, filii, inseri oportuit ad intellectus vestri præparationem, quæ res sola nunc agitur. Duplex enim est animorum præoccupatio seu mala in-

after either *Paracelsum* or *vocalem*. But the sense seems to require the clause to be taken parenthetically.

[1] *Pulmones vulpis lienem juvant, non autem phthisin ut scriptum.* Vid. Plin. xxviii. 87. — R. L. E.

clinatio ad nova, quando ea proponi contigerit: una ab insita opinione de placitis receptis, altera ab anticipatione sive præfiguratione erronea de re ipsa quæ affertur, ac si pertineret ad aliqua ex jampridem damnatis et rejectis, aut saltem ad ea quæ animus ob levitatem aut absurditatem fastidit. Itaque jam reversi de signis dispiciamus. Atque, filii, inter signa nullum est magis certum aut nobile quam ex fructibus. Quemadmodum enim in religione cavetur ut fides ex operibus monstretur, idem etiam ad philosophiam optime traducitur, ut vana sit quæ sterilis. Atque eo magis, si loco fructuum uvæ vel olivæ, producat disputationum et contentionum carduos et spinas. De vestra autem philosophia vereor ne nimis vere cecinerit poeta non solum illo carmine,

Infelix lolium et steriles dominantur avenæ: [1]

Sed et illo,

Candida succinctam latrantibus inguina monstris. [2]

Videtur enim illa ex longinquo visa virgo, specie non indecora, sed partibus superioribus: habet enim generalia quædam non ingrata, et tanquam invitantia; cum vero ad particularia ventum sit, veluti ad uterum et partes generationis, atque ad id ut aliquid ex se edat, tum demum loco operum et actionum, quæ contemplationis proles est digna et legitima, monstra illa invenias resonantia et oblatrantia, et ingeniorum naufragiis famosa. Atque hujus mali author imprimis Aristoteles, altrix ista vestra philosophia. Illi enim vel ludo vel gloriæ erat, quæstiones minus utiles primo subornare, deinde confodere; ut pro assertore veritatis contradictionum artifex sit. Pessimo enim et exemplo et successu scientia traditur per quæstiones subminis-

[1] Georg. i. 154. [2] Æn. vi. 75.

tratas earumque solutiones. Qui enim bene affirmat et probat et constituit et componit, is errores et objectiones longe summovet et veluti eminus impedit et abigit: qui autem cum singulis colluctatur, is exitum rei nullum invenit sed disputationes serit. Quid enim opus sit ei qui unum luminis et veritatis corpus clarum et radiosum in medio statuit, parva quædam et pallida confutationum ellychnia ad omnes errorum angulos circumferre, solventi alia dubia, alia per ipsam illam solutionem excitanti ac veluti generanti? Verum id curæ, ut videtur, præcipue fuit Aristoteli, ut homines haberent parata in singulis quæ pronunciarent, quæ responderent, et per quæ se expedirent, potius quam quid penitus crederent, aut liquido cogitarent, aut vere scirent. Philosophia autem vestra tam bene authorem refert, ut quæstiones quas ille movit illa figat et faciat æternas: ut quæri videatur, non ut veritas eruatur, sed ut disputatio alatur: adeo ut Nasicæ sententia illi Catonis præponderet.[1] Neque enim illud agitur ut temporis progressu sublatis dubiis tanquam hostibus a tergo ad ulteriores provincias penetretur; sed ut perpetuæ istæ quæstiones, tanquam Carthago, militiam istam disputandi exerceant. Quod vero ad operum fructum et proventum attinet: existimo ex ista philosophia, per tot annorum spatia laborata et culta, ne unum quidem experimentum adduci posse, quod ad hominum statum levandum et locupletandum spectet, et philosophiæ speculationibus vere acceptum referri possit: adeo ut brutorum animalium instinctus plura inventa peperint, quam doctorum hominum sermones. Nam Celsus ingenuo et prudenter fatetur, ex-[illegible] medicinæ primo inventa fuisse, ac postea

[1] Plutarch in Catone, [illegible] — R. L. E.

homines circa ea philosophatos esse, et causas explorasse et assignasse; non ordine inverso evenisse, ut ex philosophia et causarum cognitione ipsa experimenta deprompta essent. Neque hic finis. Non male enim merita esset philosophia ista de practica, licet eam experimentis non auxisset, si tamen usum ejus castiorem et prudentiorem reddidisset (quod fortasse facit), atque interim ejus incrementis et progressibus nihil obfuisset. Illud autem magis damnosum et perniciosum, quod inventa non solum non edat, sed etiam opprimat et extinguat. Nam affirmare licet, filii, verissime, Aristotelis de quatuor elementis commentum, rem certe obviam et pinguem (quia hujusmodi corpora in maxima quantitate et mole cernuntur), cui tamen ille potius authoritatem quam principium dedit (cum Empedoclis esset;[1] a quo etiam melius erat positum); quod postea avide a medicis arreptum, quatuor complexionum, quatuor humorum, quatuor primarum qualitatum conjugationes post se traxit; tanquam malignum et infaustum sidus infinitam et medicinæ et compluribus rebus mechanicis sterilitatem attulisse; dum homines per hujusmodi concinnitates et compendiosas ineptias sibi satisfieri patientes, nil amplius curant; et vivas et utiles rerum observationes prorsus omiserunt. Itaque si illud verum, *ex fructibus eorum*, videtis certe quo res redierit. Agite vero, filii, et signa ex incrementis capiamus. Certe si ista doctrina plane instar plantæ a stirpibus suis revulsæ non esset, sed gremio et utero naturæ adhæreret, atque ab eadem aleretur; id minime eventurum fuisset, quod per annos bis mille jam fieri videmus, ut

[1] That Empedocles was the first is said by Arist. *Met.* i. 3. — *R. L. E.* The words within the parenthesis are not found in the corresponding passage of the *Cogitata et Visa*.

scientiæ in eodem fere statu maneant et hæreant, neque augmentum aliquod memorabile sumpserint. Polluntur fortasse nonnunquam ab aliquo, et illustrantur et accommodantur (dum tamen interim ab infinitis lacerentur et deformentur et inquinentur), sed utcunque non dilatantur aut amplificantur. In artibus autem mechanicis contra evenire videmus; quæ ut spiritu quodam repletæ vegetant et crescunt; primo rudes, deinde commodæ, post excultæ, sed perpetuo auctæ. Philosophia autem et scientiæ intellectus statuarum more adorantur et celebrantur, sed non moventur. Quinetiam in primo nonnunquam authore maxime florent, et deinceps declinant et exarescunt. Neque vero mirum est ista discrimina inter mechanicam et philosophiam conspici, cum in illa singulorum ingenia misceantur, in hac corrumpantur et destruantur. Quod si quis existimet, scientiarum ut rerum cæterarum esse quendam statum, idque fere in tempus unius authoris incidere, qui beneficio temporis usus, et suæ ætatis princeps, inspectis reliquis scriptoribus et judicatis, scientias ipsas absolvat et perficiat; quod postquam factum sit, juniores rite palmas secundas petere, ut hujusmodi authoris opera vel explicent vel digerant, vel pro sui sæculi ratione palato accommodent et vertant: næ ille majorem rebus humanis prudentiam et ordinem et felicitatem tribuit, quam experiri fas est; res enim casum recipit, nisi quod vanitas hominum etiam fortuita in deterius detorquet. Nam vero sic se res habet; postquam scientia aliqua multorum observatione et diligentia, dum alius alia apprehendit, per partes tentata serio et tractata sit, tum exoriri aliquem mente fidentem, lingua potentem, methodo calidum, qui corpus unum ex singulis pro suo ingenio efficiat et posteris tradat: plerisque corruptis

et depravatis, et cum certissima omissione omnium quæ altiores et digniores contemplationes exhibere possint, ut opinionum immodicarum et extravagantium: et posteri rursus facilitate rei et compendio gaudentes, sibi gratulantur ac nil ulterius quærunt, sed ad illa ministeria servilia quæ diximus se convertunt. Verum vobis, filii, pro certo sit, quæ in natura fundata sunt, ut aquas perennes, perpetuo novas scaturigines et emanationes habere; quæ autem in opinione versantur, variari fortasse sed non augeri. Habemus et aliud signum; si modo signi appellatio in hoc competit, cum potius testimonium sit, imo testimoniorum omnium validissimum; hoc est propriam authorum quorum fidei vos committitis confessionem et judicium. Nam et illi ipsi qui dictaturam quandam in scientiis invaserunt, et tanta fiducia de rebus pronuntiant, tamen per intervalla, cum ad se redeunt, ad querimonias demum de naturæ subtilitate, rerum obscuritate, humani ingenii infirmitate, et similia se convertunt. Neque propterea, filii, hæc modestiæ aut humilitati, virtutibus in rebus intellectualibus omnium felicissimis deputetis: non tam faciles, aut boni fueritis: cum contra, ista non confessio, sed professio sive prædicatio, ex superbia, invidia, atque id genus affectibus ortum pro certo habeat; id enim prorsus volunt, quicquid in scientiis sibi ipsis aut magistris suis incognitum aut intactum fuerit, id extra terminos possibilis poni et removeri: hæc est illa modestia atque humilitas. Itaque pessimo fato res geritur. Nil enim in his rerum humanarum angustiis aut ad præsens magis deploratum aut in futurum magis ominosum est, quam quod homines ignorantiam etiam ignominiæ (ut nunc fit) eximant, atque artis suæ infirmitatem in naturæ calumniam vertant; et quicquid ars illa sua non

attingit, id ex arte scitu aut factu impossibile supponant. Neque sane damnari potest ars, cum ipsa judicet. Ex hoc fonte haud paucas opiniones et placita in philosophia reperiatis, quæ nihil aliud quam quæsitam istam et artificiosam et in cognoscendo et in operando desperationem, ad artis decus et gloriam perditissimo hoc modo tuendum, sapiant et foveant. Hinc schola Academica, quæ Acatalepsiam ex professo tenuit, et homines ad sempiternas tenebras damnavit. Hinc opinio, quod formæ sive veræ rerum differentiæ inventu impossibiles sunt; ut homines in atriis naturæ perpetuo obambulent, nec intra palatium aditum sibi muniant. Hinc positiones illæ infirmissimæ, calorem solis et ignis toto genere differre, atque compositionem opus hominis, mistionem opus solius naturæ esse; ne forte ars naturam, ut Vulcanus Minervam,[1] sollicitare aut expugnare tentet aut speret; et complura hujusmodi, quæ tam ad confessionem tenuitatis propriæ, quam ad repressionem[2] industriæ alienæ pertinent. Itaque neutiquam vobis, filii, pro amore et indulgentia nostra consuluero, ut cum rebus non solum desperatis sed et desperationi devotis fortunas vestras misceatis. Verum, filii, tempus fugit, dum capti amore et rerum et vestrum circumvectamur, ac omnia movemus, et initiationem hanc vestram, instar Aprilis aut veris cujusdam ad congelationem omnem et obstinationem solvendam et aperiendam esse cupimus. Restat signum certissimum de modis. Modi enim faciendi sunt potentiâ res ipsæ; et prout bene aut prave institutæ fuerint, ita res et effecta se habent. Itaque

[1] Schol. in Il. B. 547. — *R. L. E.*

[2] The words *tenuitatis . . . repressionem* are inserted between the lines in Bacon's hand. And there are two or three other interlineations in the latter part of the MS. of the same kind, where it is evident (as it is here) that words had been omitted by the carelessness of the transcriber.

si modi hujus vestræ philosophiæ condendæ nec debiti sint nec probabiles, non videmus quam spem foveatis, nisi credulam et levem. Atque certe, filii, si obeliscus aliquis magnitudine insignis ad triumphi fortasse aut hujusmodi magnificentiæ decus transferendus esset, atque id homines nudis manibus tentarent; annon eos helleboro opus habere cogitaretis? quod si numerum operariorum augerent, atque hoc modo se valere posse confiderent, annon tanto magis? quod si etiam delectum adhiberent, et imbecilliores separarent, et robustis tantum et vigentibus uti vellent, et hinc demum se voti compotes fore præsumerent, aut ne hoc quidem contenti, etiam artem athleticam consulerent, ac omnes cum manibus et lacertis et nervis ex arte bene unctis et medicatis adesse juberent; annon prorsus eos dare operam ut cum ratione quadam et prudentia insanirent, clamaretis? Et tamen simili homines malesano impetu feruntur in intellectualibus, dum intellectum veluti nudum applicant, et ab ingeniorum vel multitudine vel excellentia magna sperant, vel etiam dialecticis, quæ mentis quædam athletica censeri possit, ingeniorum nervos roborant; neque machinas adhibent, per quas vires et singulorum intendantur et omnium coëant. Atque ut menti debita auxilia non subministrant; ita nec naturam rerum debita observantia prosequuntur. Quid enim dicemus? an nihil aliud est philosophiam condere, quam ex paucis vulgaribus et obviis experimentis de natura judicium facere, ac dein tota sæcula in meditationibus volutare? Atque, filii, nesciebam nos tam naturæ fuisse familiares, ut ex tam levi et perfunctoria salutatione ea nobis aut arcana sua patefacere, aut beneficia impertire dignaretur. Certe nobis perinde facere videntur homines, ac si naturam ex longinqua et

præ-alta turri despiciant et contemplentur; quæ imaginem ejus quandam, seu nubem potius imagini similem, ob oculos ponat: rerum autem differentias (in quibus res hominum et fortunæ sitæ sunt), ob earum minutias et distantiæ intervallum, confundat et abscondat. Et tamen laborant et nituntur, et intellectum tanquam oculos contrahunt, ejusdemque aciem meditatione figunt, agitatione acuunt, quinetiam artes argumentandi veluti specula artificiosa comparant, ut istiusmodi differentias et subtilitates naturæ mente comprehendere et vincere possint. Atque ridicula certe esset et præfracta sapientia et sedulitas, si quis ut perfectius et distinctius cerneret, vel turrim conscendat vel specula applicet vel palpebras adducat, cum ei liceat absque universa ista operosa et strenua machinatione et industria fieri voti compos per rem facilem, et tamen ista omnia beneficio et usu longe superantem: hoc est, ut descendat et ad res propius accedat. Atque certe in intellectus usu similis nos exercet imprudentia. Neque, filii, postulare debemus ut natura nobis obviam eat: sed satis habemus, si accedentibus nobis, idque cultu debito, se conspiciendam det. Quod si cui in mentem veniat opinari tale quippiam: etiam antiquos atque ipsum Aristotelem proculdubio a meditationum suarum principio magnam vim et copiam exemplorum sive particularium paravisse, atque eandem viam, quam nos veluti novam indicamus et signamus, revera iniisse et confecisse, adeo ut actum agere videri possimus: certe, filii, hæc de illis cogitare non est integrum; formam enim et rationem suam inquirendi et ipsi profitentur et scripta eorum imaginem expressam præ se ferunt. Illi statim ab inductionibus nullius pretii ad conclu-

maxime generales, tanquam disputationum polos,

advolabant, ad quarum constantem et immotam veritatem reliqua expediebant. Verum scientia constituta, tum demum siqua controversia de aliquo exemplo vel instantia mota esset, ut positis suis refragante, non id agebant ut positum illud emendaretur; sed, posito salvo, hujusmodi instantias quæ negotium faciebant, aut per distinctionem aliquam subtilem et sapientem in ordinem redigebant, aut per exceptionem plane (homines non mali) dimittebant.[1] Quod si instantiæ aut particularis rei, non contradictoriæ reconciliatio, sed obscuræ ratio, quæreretur, eam ad speculationes suas quandoque ingeniose accommodabant, quandoque misere torquebant: quæ omnis industria et contentio res sine fundamento nobis videtur. Itaque nolite commoveri, quod frequens alicubi inter nonnulla Aristotelis scripta inveniatur exemplorum et particularium mentio. Noveritis enim, id sero et postquam decretum fuisset factum fuisse. Illi enim mos erat non liberam experientiam consulere, sed captivam ostentare; nec eam ad veritatis inquisitionem promiscuam et æquam, sed ad dictorum suorum fidem sollicitatam et electam adducere. Neque rursus tale aliquod vobiscum cogitate, eam quam nos tantopere desideramus differentiarum subtilitatem in distinctionibus philosophorum scholasticorum haberi, atque adeo elucescere: neque enim existimetis, ab hac præpostera subtilitate primæ negligentiæ et festinationi et temeritati subventum esse. Longe abest, filii, ut hoc fieri possit; quin credite mihi, quod de fortuna dici solet id de natura verissimum est, eam a fronte capillatam, ab occipitio calvam esse. Omnis enim ista sera subtilitas et diligentia, postquam verum tempus observationis præterierit, naturam prensare aut captare potest,

[1] *dimittebant* in MS.

[illegible] capere. Equidem satis [illegible] post experiemini, postquam [illegible] et differentiis in ex- [illegible] et sensui subjectis aut [illegible] paululum insu- [illegible] alteram disputa- [illegible] vestras non sine [illegible] quasi pro re [illegible] habituri sitis. [illegible] vis et ego, filii, [illegible] condendæ [illegible] et amplitu- [illegible] atque. inter [illegible] et legitimum [illegible] precati etiam [illegible] pater est, [illegible] sed stirps [illegible] hoc est in- [illegible] humanas (quan- [illegible] suscipiatur. [illegible] facultates artium [illegible] aut ratio- [illegible] adhuc [illegible] more, conge- [illegible] aranearum [illegible] est, quæ [illegible] sed simul [illegible] Neque [illegible] est, quæ ex his- [illegible] præbitam [illegible] sed in intellectu [illegible] hujusmodi mellis

cœlestia dona sperate: neque dicite cum pigro, Leo est in via: sed vincla quæ vos premunt excutite, et vos recipite. Atque sane, post virtutem vestram propriam, nihil animos vobis magis addiderit, quam si industriam et felicitatem et facinora ætatis nostræ cogitetis. Nos nostrum *plus ultra* antiquorum *non ultra* haud vane opposuimus. Nos iidem, contra antiquorum *non imitabile fulmen* esse, *imitabile fulmen* esse, minime dementes sed sobrii, ex novarum machinarum experimento et demonstratione pronuntiamus. Quin et cœlum ipsum imitabile fecimus. Cœli enim est, circuire terram: quod et nostræ navigationes pervicerunt. Turpe autem nobis sit, si globi materiati tractus, terrarum videlicet et marium, nostris temporibus in immensum aperti et illustrati sint: globi autem intellectualis fines, inter veterum inventa et angustias steterint. Neque parvo inter se nexu devincta et conjugata sunt ista duo, perlustratio regionum et scientiarum. Plurima enim per longinquas navigationes et peregrinationes in natura patuerunt, quæ novam sapientiæ et scientiæ humanæ lucem affundere possint, et antiquorum opiniones et conjecturas experimento regere. Eadem duo, non ratione solum sed etiam vaticinio, conjuncta videntur. Nam eo prophetæ oraculum haud obscure spectare videtur, ubi de novissimis temporibus loquutus, illud subjungit, *Multi pertransibunt, et multiplex erit scientia:* ac si orbis terrarum pertransitus sive peragratio, et scientiarum augmenta sive multiplicatio, eidem ætati et sæculo destinarentur. Præsto etiam est Imprimendi artificium veteribus incognitum, cujus beneficio singulorum inventa fulguris modo transcurrere possint et subito communicari, ad aliorum studia excitanda et inventa miscenda. Quare utendum est ætatis nostræ prærogativa, neque committendum, ut

cum hæc tanta vobis adsint vobis ipsi desitis. Nos autem, filii, ab animorum vestrorum præparatione auspicati, in reliquis vobis non deerimus. Probe enim novimus tabellas mentis a tabellis communibus differre. In his non alia inscripseris nisi priora deleveris, in illis priora ægre deleveris nisi nova inscripseris. Itaque rem in longum non differemus: illud itidem vos monentes, ne tanta vobis de nostris inventis polliceamini, quin meliora a vobis ipsis speretis. Nos enim Alexandri fortunam nobis spondemus (neque vanitatis nos arguatis antequam rei exitum audiatis); illius enim res gestæ recenti memoria ut portentum accipiebantur; ita enim loquitur unus ex æmulis oratoribus, *Nos certe vitam humanam non degimus; sed in id nati sumus, ut posteri de nobis portenta prædicent;* sed postquam deferbuisset ista admiratio atque homines rem attentius introspexissent, operæ pretium est animadvertere, quale judicium de eo faciat scriptor Romanus, *Nil aliud quam bene ausus est vana contemnere.* Ita et nos simile quiddam a posteris audiemus; postquam emancipati, et sui jam facti, et proprias vires experti, initia nostra magnis intervallis superaverint. In quo sane judicio, illud recte, nostra nil magni esse: illud non recte, si ausis tribuant quæ humilitati debentur: humilitati (inquam) et privationi cuidam istius humanæ superbiæ, quæ universa perdidit, quæque volucres quasdam meditationes loco divinas in rebus signaturæ consecravit. Hac enim ex parte revera nobis gratulamur, et eo nomine felices nos et bene de genere humano meritos esse existimamus, quod ostendimus quid vera et legitima spiritus humani humiliatio possit. Verum quid nobis ab hominibus debeatur, qui viderint. Nos certe nos nostraque vobis debemus.

Omnibus qui aderant digna magnitudine generis et

nominis humani oratio visa est, et tamen libertati quam arrogantiæ propior. Ita autem inter se colloquebantur: se instar eorum esse, qui ex locis opacis et umbrosis in lucem apertam subito exierint, cum minus videant quam prius; sed cum certa et læta spe facultatis melioris.

Tum ille qui hæc narrabat; tu vero quid ad ista dicis? inquit. Grata sunt (inquam) quæ narrasti. Atque (inquit) si sunt ut dicis grata, si tu forte de his rebus aliquid scripseris, locum invenias ubi hæc inseras, neque peregrinationis nostræ fructus perire patiaris. Æquum postulas, inquam, neque obliviscar.

FRANCISCI BACON

COGITATA ET VISA:

DE

INTERPRETATIONE NATURÆ, SIVE DE SCIENTIA OPERATIVA.

FRANCISCI BACON

COGITATA ET VISA:

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INTERPRETATIONE NATURÆ, SIVE DE SCIENTIA OPERATIVA.

PREFACE

TO THE

COGITATA ET VISA.

THE *Cogitata et Visa* stands first in Gruter's volume of 1653, where it first appeared. That a work with that title was composed about the year 1607 may be inferred from the date (1607) of a letter addressed by Bacon to Sir Thomas Bodley "after he had imparted to him a writing entitled *Cogitata et Visa;*" from a letter addressed (19 Feb. 1607) by Sir Thomas Bodley to Bacon, giving his opinion of it; and from an entry in the *Commentarius Solutus* (26 July, 1608) "Imparting my *Cogitata et Visa*, with choice, ut videbitur." Whether the writing here spoken of was exactly the same as that which Gruter published it is of course impossible to say. The following allusion in Bacon's letter to Bodley — "If you be not of the lodgings chalked up, whereof I speak in my preface" — would seem rather to imply that it was not; there being no preface to the *Cogitata* as printed by Gruter, nor any allusion to the chalked lodgings anywhere in the work. And it is otherwise probable that it underwent many alterations before it attained its final shape, in which it must certainly be reckoned among the most perfect of Bacon's productions. Allowance being made

15.03A

however for this uncertainty, we need not scruple to place it here. It covers most of the ground occupied by the first book of the *Novum Organum*, and was intended to be followed by an example of a true inductive investigation, with all its apparatus of tables, &c., as applied to one or two particular subjects; which would have covered the same ground which the second book of the *Novum Organum* was meant to occupy.

For the text, there are only two authorities that I know of; namely the copy printed by Gruter, and a manuscript in the library of Queen's College, Oxford;[1] a very beautiful manuscript, carefully corrected throughout in Bacon's own hand, and perfect but for the loss of a leaf in the middle. The differences between the two, though not otherwise material, are sufficient to prove that neither can have been taken from the other; and as the manuscript is fuller in some places, and the printed copy in others, it is difficult to say which was the later. The manuscript however is certainly the more accurate; and has certainly been revised by Bacon himself, — a fact which we cannot be so sure of with regard to the other. I have therefore, by permission of the Provost of Queen's College, printed the text from it; giving in the notes the readings of Gruter's copy, where there is any difference between them.

The notes which do not relate to these variations are Mr. Ellis's.

J. S.

[1] CCLXXX. fo. 205.

FRANCISCI BACON

COGITATA ET VISA:

DE

INTERPRETATIONE NATURÆ, SIVE DE SCIENTIA OPERATIVA.[1]

Franciscus Bacon sic cogitavit; Scientiam in cujus possessione genus humanum adhuc versatur, ad certitudinem et magnitudinem operum non accedere. Medicos siquidem morbos complures insanabiles pronuntiare, et in reliquorum cura sæpius errare et deficere: Alchimistas in spei suæ amplexibus senescere et immori: Magorum opera fluxa, nec fructuosa: Mechanicas artes non multum lucis a philosophia petere, sed experientiæ telas, lentas sane ac humiles, paulatim continuare: Casum, authorem rerum proculdubio utilem; sed qui per longas ambages et circuitus donaria sua in homines spargat. Itaque visum est ei, Inventa hominum quibus utimur admodum imperfecta et immatura censeri: Nova vero, hoc scientiarum statu, nonnisi per sæculorum spatia expectari; eaque ipsa quæ hactenus humana exhibuit industria, Philosophiæ haud attribui.

Cogitavit et illud; in his[2] rerum humanarum an-

[1] The title in Gruter's copy is: *Francisci Baconi De Verulamio, Cogitata et Visa de Interpretatione Naturæ, sive de Inventione Rerum et Operum.*

[2] *iis.* — G.

gustiis, id maxime et ad præsens deploratum et in futurum ominosum esse; quod homines, contra bonum suum, cupiunt ignorantiam ignominiæ eximere, et sibi per inopiam istam satisfieri. Medicus enim præter cautelas practicæ[1] suæ (in quibus ad existimationem Artis tuendam haud parum præsidii est), hanc generalem veluti totius Artis cautelam advocat; quod Artis suæ infirmitatem in Naturæ calumniam vertit, et quod Ars non attingit, id ex arte impossibile in Natura supponit. Neque certe damnari potest Ars, cum ipsa judicet. Etiam Philosophia ex qua medicina ista (quam in manibus habemus) excisa est, habet et illa et in sinu nutrit quædam posita aut placita, in quæ si severius inquiratur, hoc omnino persuaderi volunt, Nil arduum aut in natura imperiosum ab arte vel ope humana expectari debere. Ab hoc fonte illud: Calorem Astri sive Solis et calorem Ignis toto genere differre: et illud, Compositionem opus hominis, at Mistionem opus solius naturæ esse, et similia: quæ si diligentius notentur, omnino pertinent ad humanæ potestatis circumscriptionem malitiosam, et ad quæsitam et artificiosam desperationem, quæ non solum spei auguria sed etiam experiendi aleas abjiciat, et omnis[2] industriæ stimulos et nervos incidat;[3] dum de hoc tantum soliciti sunt, ut Ars perfecta censeatur, et gloriæ vanissimæ et perditissimæ dant operam, scilicet ut quicquid inventum non sit, id nec inveniri posse credatur. Alchimista vero, ad Artis suæ sublevationem, errores proprios reos substituit; secum accusatorie reputando, se aut Artis et Authorum vocabula non satis intel-

[1] *artis.* — G. [2] *omnes.* — G.

[3] Compare this with what is said of Galen in the *Temporis Partus Masculus* [supra, p. 20.].

lexisse, unde ad traditionum et ore tenus eloquiorum susurros animum applicat; aut in practicæ scrupulis, proportionibus et momentis aliquid titubatum esse, unde experimenta fœlicioribus (ut putat) auspiciis in infinitum repetit: ac interim, cum inter experimentorum vertiginosas ambages[1] in Inventa quædam aut ipsa facie nova, aut utilitate non contemnenda impingat, hujusmodi pignoribus animum pascit, eaque in majus ostentat et celebrat, reliqua spe sustentat. Magus, cum nonnulla supra naturam (pro suo nimirum captu) prorsus effici videat; postquam vim semel naturæ factam intelligit, imaginationi alas addit, remque magis et minus recipere vix putat; quare maximarum rerum sibi adeptionem spondet; non videns esse subjecta certi cujusdam et fere definiti generis, in quibus Magia et superstitio per omnes nationes et ætates potuerit et luserit. Mechanicus autem, si ei contigerit jam pridem inventa subtilius polire, vel ornare elegantius; aut quæ separatim observaverit componere et simul repræsentare; aut res cum usu rerum commodius et fœlicius copulare; aut opus majore aut etiam minore quam fieri consuevit mole et volumine exhibere; se demum inter rerum Inventores numerat. Itaque satis constabat ei, homines rerum Inventionem ut conatum irritum fastidire;[2] vel credere, extare quidem Inventa nobilia, sed inter paucos summo silentio et religione quadam cohiberi; vel huc descendere, ut minores istas industrias et Inventorum additamenta

[1] This remarkable phrase occurs also in the *Temporis Partus Masculus* [see p. 31.]; a coincidence which, with other points of resemblance, seems to indicate that the *Cogitata et Visa* and the *Temporis Partus* were written about the same time.

[2] *Itaque visum est ei, homines rerum et artium novarum inventionem, ut conatum inanem et suspectum, fastidire.* — G.

pro novis Inventis æstiment; quæ omnia eo redeunt, ut animos hominum a legitimo et constanti labore, et a nobilibus et genere humano dignis Inventorum pensis avertant.

Cogitavit et illud; homines cum operum varietatem et pulcherrimum apparatum, quæ per artes Mechanicas ad cultum humanum congesta sit,[1] oculis subjiciant;[2] eo inclinare, ut potius ad opulentiæ humanæ admirationem quam ad inopiæ sensum accedant; minime videntes, primitivas hominis observationes et Naturæ operationes quæ animæ aut primi motus instar ad omnem illam varietatem sint, nec multas nec alte petitas esse: cætera ad patientiam hominum, et subtilem et ordinatum manus vel instrumentorum motum tantum[3] pertinere: atque in hac parte officinam cum Bibliotheca mire congruere, quæ et ipsa tantam librorum varietatem ostentet, in quibus si diligentius introspicias, nil aliud quam ejusdem rei infinitas repetitiones reperias, tractatu[4] novas, inventione præoccupatas. Itaque visum est ei, opinionem copiæ inter causas inopiæ poni: et tum opera tum doctrinas ad intuitum numerosa, ad examen pauca esse.

Cogitavit et illud; eas quas habemus doctrinas ea ambitione et affectatione proponi, atque in eum modum efformatas ac veluti personatas in conspectum venire, ac si singulæ artes omni ex parte perfectæ essent et ad exitum perductæ. Hujusmodi enim methodis et iis partitionibus tradi, quæ omnia prorsus quæ in illud subjectum cadere possunt tractatu[5] complecti et concludere videantur. Atque licet membra illa male impleta et quod ad vividum aliquem rerum succum

[1] *sunt.* — G. [2] *subjiciunt.* — G. [3] *tantum* om. G.
[4] *tractandi modis et structura quadam.* — G. [5] *tractata.* — G.

attinet destituta sint, Totius tamen cujusdam formam et rationem præ se ferre: eoque rem perduci, ut pauca quædam, neque illa ex optimo delectu recepta Authorum scripta, pro integris ipsis et propriis Artibus habeantur. Cum tamen primi et antiquissimi veritatis inquisitores, meliore fide ac eventu, Scientiam quam ex rerum contemplatione decerpere et in usum condere statuebant, in Aphorismos fortasse sive breves easdemque sparsas nec methodis revinctas sententias, conjicere solerent: quæ cum et rerum inventarum nuda simulachra, et rerum non inventarum manifesta spatia et vacua indicarent, minus fallebant; atque hominum ingenia et meditationes ad judicandum et ad inveniendum simul excitabant. At nunc scientias iis modis exhiberi quæ fidem usurpent, non judicium solicitent, et authoritate tristi lætis Inventionum conatibus intercedant: Adeo ut omnis successio et devolutio disciplinarum personas Magistri et auditoris complectatur, non Inventoris et ejus qui Inventis addat: unde necessario evenire, ut Scientiæ suis hæreant vestigiis, nec loco omnino moveantur; quod et per multa jam sæcula usuvenit; eousque, ut non solum assertio maneat assertio, sed etiam quæstio maneat quæstio, et eodem plane statu alatur. Quare visum est ei, Columnas non ultra progrediendi magnopere fixas esse;[1] et mirum minime esse id haud obtineri, cujus adipiscendi homines nec spe nec desiderio teneantur.

Cogitavit et illud; quæ de hominum tum desperatione tum fastu dicta sunt, quod ad plerosque scientiarum sectatores attinet, nimis alte petita esse. Turbam enim longe maximam prorsus aliud agere: Doctrinam siquidem vel animi et delectationis causa petere, vel

[1] *fixas esse et quasi fatales.* — G.

ad usum et emolumentum professorium, vel etiam ad ornamentum et existimationis suæ adminiculum: Quæ si ut fines[1] scientiarum proponantur, tantum abest ut homines id velint, ut ipsa doctrinarum massa augmentum sumat; ut ex ea quæ præsto est massa, nil amplius quærant quam quantum ad usum destinatum vertere et decoquere possint. Si quis autem in tanta multitudine scientiam affectu ingenuo et propter se expetat; invenietur tamen rerum potius varietatem[2] quam veritatem aucupari: Quod si et veritatis sit inquisitor severior, illa ipsa tamen veritas erit hujusmodi, quæ res jam in lucem proditas subtilius explicet; non quæ novam lucem excitet. Sin adhuc studium cujuspiam in tantum expandatur, ut et novam lucem ambiat; eam scilicet lucem adamabit, quæ ex longinquo contemplationes speciosas ostentet, non quæ ex propinquo opera et Inventa nobilia demonstret. Quare visum est ei, eodem rursus referri; scilicet mirum non utique esse curriculum non confici, cum homines ad hujusmodi minora deflectant: multo magis, cum nec ipsa meta adhuc ulli quod sciat mortalium posita sit et defixa: Metam autem non aliam esse, quam ut genus humanum novis operibus et potestatibus continuo dotetur.

Cogitavit et illud; inter ista Scientiarum detrimenta, Naturalis philosophiæ sortem præ omnibus minus æquam esse: ut quæ a laboribus hominum leviter occupata, facile deserta, nec majorem in modum culta et subacta sit. Postquam enim fides Christiana adoleverit et recepta sit,[3] longe maximam ingeniorum partem ad Theo-

[1] *finis.* — G.

[2] There is here perhaps an allusion to the title of one of Cardan's works, *De Rerum Varietate;* of which Bacon made use in writing the *Sylva Sylvarum.*

[3] *adolevit et recepta est.* — G.

logiam se contulisse, hominumque ex hac parte studio et amplissima præmia proposita et omnis generis adjumenta copiosissime subministrata esse: quin et ævo superiore potissimas Philosophorum commentationes in Morali Philosophia (quæ Ethnicis[1] vice Theologiæ erat) consumptas esse: utrisque autem temporibus summa ingenia haud infrequenti numero ad res civiles se applicasse, præsertim durante magnitudine Romana, quæ ob imperii amplitudinem plurimorum operis indigebat. Eam ipsam vero ætatem qua Naturalis Philosophia apud Græcos maxime florere visa est, fuisse particulam temporis minime diuturnam: ac subinde contradictionibus ac novorum placitorum ambitione corruptam et inutilem redditam. Ab illis autem usque temporibus, neminem prorsus nominari, qui Naturalem Philosophiam ex professo colat, nec ejus inquisitioni immoriatur; adeo ut virum vacuum et integrum hæc Scientia jamdiu non occupaverit; nisi forte quis[2] monachi alicujus in cellula aut nobilis in villula lucubrantis exemplum adduxerit, quod et rarissimum reperietur. Sed factam[3] deinceps instar transitus cujusdam et pontisternii ad alia, magnamque istam Scientiarum matrem in ancillam mutatam esse; quæ Medicinæ aut Mathematicis operibus ministret, aut adolescentium immatura ingenia lavet et imbuat veluti tinctura quadam prima, ut aliam rursus fœlicius et commodius excipiant. Itaque visum est ei Naturalem Philosophiam, incumbentium et paucitate, et festinatione, et tyrocinio, destitutam jacere. Nec ita multo post visum est ei, hoc ad universum doctrinarum statum summopere pertinere. Omnes enim artes et scientias ab hac stirpe revulsas poliri fortassis, aut in usum effingi, sed nil admodum crescere.

[1] *Ethnicis, magna ex parte.* — G. [2] *quis forte.* — G. [3] *factum.* — G.

Cogitavit et illud; quam molestum ac in omni genere difficilem adversarium nacta sit Philosophia naturalis, Superstitionem nimirum et zelum religionis cæcum et immoderatum. Comperit enim ex Græcis nonnullos, qui primum causas naturales fulminis et tempestatum insuetis adhuc hominum auribus proposuerunt, impietatis eo nomine damnatos; nec multo melius exceptos, sed in idem judicium adductos, non capitis sane sed famæ, Cosmographos, qui ex certissimis demonstrationibus, quibus nemo hodie sanus contradixerit, formam terræ rotundam tribuerunt, et ex consequenti Antipodas asseruerunt, accusantibus quibusdam ex antiquis Patribus fidei Christianæ.[1] Quin et duriorem (ut nunc sunt res) conditionem sermonum de Natura effectam ex temeritate Theologorum Scholasticorum et eorum clientelis, qui cum Theologiam (satis pro potestate) in ordinem redegerint et in artis fabricam effinxerint, hoc insuper ausi sunt, ut contentiosam et tumultuariam Aristotelis Philosophiam corpori religionis inserverint.[2] Eodem spectare etiam, quod hoc sæculo haud alias opiniones[3] magis secundis ventis ferri reperies, quam eorum qui Theologiæ et Philosophiæ, (id est) fidei[4] et sensus, conjugium veluti legitimum multa pompa et solennitate celebrant, et grata rerum varietate animos hominum permulcentes, interim divina et humana inauspicato permiscent. Revera autem si quis diligentius animum advertat, non minus periculi Naturali Philosophiæ ex istiusmodi fallaci et iniquo fœdere, quam ex apertis in-

[1] See Lactantius, Div. Inst. iii. 24.; and for a defence of the conduct of S. Boniface to Virgilius Bishop of Salzburg, who maintained among other positions of doubtful orthodoxy the existence of the antipodes, see Fromondus "De orbe terræ immobili."

[2] *immiscuerint.* — G.

[3] *opiniones et disputationes.* — G.

[4] *fidem* in Gruter. — *J. S.*

imicitiis imminere. Tali enim fœdere et societate, recepta in Philosophia tantum comprehendi: aucta autem, vel addita, vel in melius mutata, etiam severius et pertinacius excludi. Denique versus incrementa, et novas veluti oras et regiones philosophiæ, omnia ex parte religionis pravarum suspicionum et impotentis fastidii plena esse. Alios siquidem simplicius subvereri, ne forte altior in Natura[1] inquisitio ultra datum et concessum sobrietatis terminum penetret; traducentes non recte ea quæ de divinis mysteriis dicuntur, quorum multa sub sigillo divino clausa manent, ad occulta Naturæ, quæ nullo interdicto separantur: Alios callidius conjicere, si media ignorentur, singula ad manum et virgulam divinam (quod Religionis ut putant maxime intersit) facilius referri; quod nil aliud est, quam Deo per mendacium gratificari velle: Alios ab exemplo metuere, ne motus et mutationes Philosophiæ in religionem incurrant et desinant: Alios denique solicitos videri, ne in Naturæ inquisitione aliquid inveniri possit quod Religionem labefactet; quæ duo cogitata incredulitatem quandam sapiunt, et sapientiam animalem: posterius autem absque impietate ne in dubitationem aut suspicionem venire potest. Quare satis constabat ei,[2] in hujusmodi opinionibus multum infirmitatis, quin et invidiæ et fermenti non parum subesse. Naturalem enim Philosophiam post verbum Dei certissimam superstitionis medicinam, eandem probatissimum fidei alimentum esse. Itaque merito religioni tanquam fidissimam et acceptissimam ancillam atribui: cum altera voluntatem Dei, altera potestatem manifestet: Neque errasse eum qui dixerit, erratis nescientes scripturas et potestatem Dei;[3] informationem de voluntate, et meditationem de potes-

[1] *naturam.* — G. [2] *ei* om. G. [3] St. Matth. xxii. 29.

tate, nexu individuo copulantem. Quæ licet verissima sint, nihilominus illud manet; in potentissimis Naturalis Philosophiæ impedimentis, ea quæ de zelo imperito et superstitione dicta sunt, citra controversiam numerari.

Cogitavit et illud; in moribus et institutis Academiarum, Collegiorum, et similium conventuum, quæ ad doctorum hominum sedes et operas mutuas destinata sunt, omnia progressui Scientiarum in ulterius adversa inveniri. Frequentiam enim multo maximam professoriam primo, ac subinde meritoriam esse: Lectiones autem et exercitia ita disposita, ut aliud a consuetis ne facile cuiquam in mentem veniat cogitare. Sin autem alicui inquisitionis et judicii libertate uti contigerit, is se in magna solitudine versari statim sentiet: Sin et hoc toleraverit, tamen in capessenda fortuna industriam hanc et magnanimitatem sibi non levi impedimento fore experietur. Studia enim hominum in ejusmodi locis in quorundam authorum scripta veluti relegata esse; a quibus si quis dissentiat, aut controversiam moveat, continuo ut homo turbidus et rerum novarum cupidus corripitur; cum tamen (si quis rerum [1] verus æstimator sit) magnum discrimen inter rerum civilium ac artium administrationem reperiet: [2] non enim idem periculum a nova luce ac a novo motu instare; verum in rebus civilibus, motum etiam in melius suspectum esse ob perturbationem; cum civilia authoritate, consensu, fama, opinione, non demonstratione et veritate constent: in artibus autem et scientiis, tanquam in metalli fodinis, omnia novis operibus et ulterioribus progressibus strepere debere. Atque recta ratione rem se ita habere. In vita autem, visum est ei doctrinarum politiam et administrationem quæ in usu est, scientia-

[1] *rerum* om. G. [2] *reperiatur.* — G.

rum augmenta et propaginem durissime premere et cohibere.

Cogitavit et illud; etiam in opinione hominum et sensu communi, multa ubique occurrere quæ novas scientiarum accessiones libero aditu prohibeant: maximam enim partem hominum, præsentibus non æquam, in antiquitatem propendere; ac credere si nobis qui nunc vivimus ea sors obvenisset, ut quæ ab antiquis quæsita et inventa sunt primi tentaremus, nos eorum pensa longo intervallo non fuisse æquaturos. Credere similiter, si quis etiam nunc, ingenio suo confisus, inquisitionem de integro suscipere affectet, hunc hujusce rei eventum fore; ut aut in ea[1] ipsa incidat quæ ab antiquitate probata sunt; aut sane in alia, quæ ab antiquitate jampridem judicata et rejecta, in oblivionem merito cessere. Alios, spreta omnino gente et facultate humana utriusque temporis, sive antiqui sive novi, in opinionem labi curiosam et superstitiosam; existimantes scientiarum primordia a spiritibus manasse, et ab eorum dignatione et consortio similiter nova inventa authoramentum habere posse.[2] Alios opinione magis sobria et severa, sed diffidentia graviore, de auctiore scientiarum statu plane desperare, Naturæ obscuritatem, brevitatem vitæ, sensuum fallacias, judicii infirmitatem, et experimentorum difficultates et immensas varietates reputando; itaque hujusmodi spei excessus, quæ majora quam quæ habemus spondeant,[3] esse impotentis animi et immaturi; atque læta scilicet principia, media ardua, extrema con-

[1] *ea* om. G.

[2] Bacon here alludes to the opinions of the cabalists, and perhaps in particular to those of Robert Fludd.

[3] *spondeat* — G. The reading of the MS. is incorrect; but it may be doubted whether the error be not in the *quæ*, which ought perhaps to be *qui*.

fusa habere. Nec minorem desperationem præmii quam facti esse. Scientias siquidem in magnis ingeniis proculdubio innasci et augeri; pretia autem et æstimationes Scientiarum, penes populum aut principes viros, aut alios mediocriter doctos esse: unde fieri[1] ut ea tantum inventa vigeant, quæ populari judicio et sensui communi accommodata sunt; ut in Democriti opinione de Atomis usuvenit, quæ quia paulo remotior erat, lusu excipiebatur. Itaque altiores contemplationes Naturæ, quas fere religionis instar duras sensibus hominum accedere necesse est, oriri aliquando posse; sed fere non multo post (nisi evidenti et excellenti utilitate demonstrentur et commendentur, quod hucusque factum non est) opinionum vulgarium ventis agitari et extingui; adeo ut tempus tanquam fluvius, levia et inflata vehere, gravia et solida mergere consueverit. Visum est ei itaque, impedimenta melioris scientiarum status non tantum externa et adventitia, sed et innata et ex ipsis sensibus hausta esse.

Cogitavit et illud; etiam verborum naturam vagam et male terminatam Intellectui hominum illudere, et fere vim facere. Verba enim certe tanquam numismata esse, quæ vulgi imaginem et principatum repræsentent: illa siquidem secundum populares notiones et rerum acceptiones (quæ maxima ex parte erroneæ sunt et confusissimæ) omnia componere et dividere; ut etiam infantes cum loqui discant,[2] infœlicem errorum cabalam haurire et imbibere cogantur: Ac licet sapientiores et doctiores se variis artibus ab hac servitute vindicare conentur; nova vocabula fingendo,

[1] *Itaque non eorundem propositionem scientiarum et judicium esse: unde fieri, &c.* — G.

[2] *discunt.* — G.

quod durum, et definitiones interponendo, quod molestum est; nullis tamen viribus jugum excutere posse, quin infinitæ etiam in acutissimis disputationibus controversiæ de verbis moveantur, et quod multo deterius est, istæ ipsæ pravæ verborum signaturæ etiam in mentem radios suos et impressiones reflectant; nec tantum in sermone molestæ, sed etiam Judicio et Intellectui infestæ sunt. Itaque visum est ei, inter internas causas errorum, hanc ipsam ut gravem sane et non[1] innoxiam ponere.

Cogitavit et illud; præter communes scientiarum et doctrinarum difficultates, philosophiam naturalem, præsertim activam et operativam, etiam alia propria habere præjudicia et impedimenta. Non parvam enim existimationis jacturam et fidei fecisse, per quosdam procuratores suos leves et vanos; qui partim ex credulitate partim ex impostura, humanum genus promissis onerarunt; vitæ prolongationem, senectutis retardationem, dolorum levationem, naturalium defectuum reparationem, sensuum deceptiones, affectuum ligationes et incitationes, intellectualium facultatum illuminationes, exaltationes, substantiarum transmutationes, motuum ad libitum multiplicationes, aëris impressiones et alterationes, rerum futurarum divinationes, remotarum repræsentationes, occultarum revelationes, et alia complura pollicitando: verum de istis largitoribus, opinari, non multum aberraturum qui istiusmodi judicium fecerit: Tantum nimirum interesse inter horum vanitates et veras artes, in philosophia, quantum intersit inter res gestas[2] Jul. Cæsaris aut Alexandri, et

[1] *non* om. *G.*

[2] So in MS. Gruter's copy has *inter stas Julii*, &c.; the *stas* commencing a new line. Blackbourn silently substituted *pugnas*, which is the

rursus Amadisii ex Gallia aut Arthuri ex Britannia, in historia; constat enim clarissimos illos Imperatores majora revera præstitisse quam umbratiles isti heroës fecisse fingantur; sed modis et viis actionum minime fabulosis et prodigiosis. Itaque æquum non esse fidem veræ memoriæ derogare, quia illa a fabulis quandoque læsa et violata sit: nam Ixionem e nube Centauros; nec ideo minus, Jovem e vera Junone Heben et Vulcanum, virtutes scilicet admirandas et divinas Naturæ et Artis genuisse. Quæ licet vera comperiantur, et homines absque rerum discrimine incrędulos esse summæ sit imperitiæ; visum tamen est ei, veritatis aditum per hujusmodi commenta interclusum aut certe arctatum jampridem esse; et vanitatis excessus etiam nunc omnem magnanimitatem destruere.

Cogitavit et illud; reperiri in animo humano inclinationem quandam a Natura insitam, et hominum opinione et disciplina nonnulla corroboratam, quæ naturalis philosophiæ, activæ nimirum et operativæ, progressus remorata sit et averterit. Eam esse opinionem sive æstimationem tumidam et damnosam; Minui nempe Majestatem mentis humanæ, si in experimentis et rebus particularibus, sensui subjectis et in materia terminatis, diu ac multum versetur: præsertim cum hujusmodi res ad inquirendum laboriosæ, ad meditandum ignobiles, ad dicendum asperæ, ad practicam illiberales, numero infinitæ, et subtilitate pusillæ, videri soleant, et ob hujusmodi conditiones gloriæ Artium minus sint accommodatæ. Quam opinionem sive animi

common reading and followed by M. Bouillet. Montagu silently substituted *istas*, which could not possibly be right. I had myself substituted *res gestas*, before I knew of the MS.; and it must of course be accepted as the true reading.

dispositionem, vires maximas sumpsisse ex illa altera opinione elata et commentitia, qua veritas humanæ mentis veluti indigena, nec aliunde commigrans; et sensus intellectum magis excitare quam informare asserebatur. Neque tamen errorem hunc, et mentis (si verum nomen quæratur) alienationem, ab iis ulla ex parte correctam, qui sensui debitas, id est primas partes tribuerunt. Quin et hos quoque exemplo et facto suo, relicta prorsus Naturali historia et mundana perambulatione, omnia in Ingenii agitatione posuisse, et inter opacissima mentis Idola, sub specioso contemplationis[1] nomine, perpetuo volutasse. Quare visum est ei, istud rerum particularium repudium et divortium omnia in familia humana turbasse.

Cogitavit et illud; non tantum ex iis quæ obstant conjecturam capiendam; fieri enim posse ut humani generis fortuna istas difficultates et vincula perfregerit et superaverit: Itaque illud videndum ac penitus introspiciendum, qualis sit ea philosophia quæ recepta sit, aut alia quæpiam ex antiquis, quæ instar tabulæ naufragii ad litora nostra impulsa sit. Atque invenit, Philosophiam Naturalem, quam a Græcis accepimus, pueritiam quandam Scientiæ censeri; atque habere id quod proprium puerorum est, ut ad garriendum prompta, ad generandum inhabilis et immatura sit. Hujus autem philosophiæ jam consensu principem Aristotelem, intacta fere ac illibata Natura, in communibus notionibus, atque earum inter se comparatione, collisione, et reductione inutiliter versatum esse. Neque sane quicquam solidi ab eo sperari, qui etiam mundum e categoriis effecerit: Parum enim interesse, utrum quis materiam formam et privationem, an sub-

[1] *contemplationis et rationalium.* — G.

stantiam qualitatem et relationem, principia rerum posuerit. Verum istis sermonibus supersederi oportere. Nam et justam confutationem instituere (cum neque de principiis, nec de demonstrationum modis conveniat) immemoris esse ; et rursus hominem tantam authoritatem et fere Dictaturam in philosophia adeptum per satyram perstringere, levius pro dignitate sermonis instituti, et tamen superbum fore. Illum sane, Dialecticis rationibus, utpote a se (quod ipse licentius gloriatur) oriundis, Naturalem philosophiam corrupisse. Verum ut illum mittamus, Platonem virum sine dubio altioris ingenii fuisse ; ut qui et formarum cognitionem ambiret, et inductione per omnia (non ad principia tantum) uteretur : sed inutili utrobique ratione, cum Inductiones vagas, formas abstractas, prensaret et reciperet. Atque hujus philosophi si quis attentius et scripta et mores consideret, eum de Philosophia Naturali non admodum solicitum fuisse reperiet, nisi quatenus ad Philosophi nomen et celebritatem tuendam, vel ad majestatem quandam moralibus et civilibus doctrinis addendam et aspergendam sufficeret. Eundem Naturam non minus Theologia, quam Aristotelem Dialectica inficere : et si verum dicendum est, tam prope ad poëtæ, quam illum [1] ad sophistæ partes accedere. Atque horum placita ex ipsis fontibus haurire licere, cum opera eorum extent. Reliquorum vero, Pythagoræ, Empedoclis, Heracliti, Anaxagoræ, Democriti, Parmenidis, Xenophanis, et aliorum, diversam rationem esse ; quod illorum opiniones per internuntios quosdam et famas et fragmenta solummodo habemus ; [2] atque idcirco majore inquisitione, ac majore etiam judicii integritate (quæ sortis

[1] *ille.* — G. [2] *habeamus.* — G.

iniquitatem levet) opus esse. Se tamen cum summa diligentia et[1] cura, omnem de illis opinionibus auram captasse; et[2] quidquid de illis, vel dum ab Aristotele confutantur, vel dum a Cicerone[3] citantur; vel in Plutarchi fasciculo, vel in Laërtii vitis, vel in Lucretii poëmate, vel alicubi in quavis alia sparsa memoria et mentione inveniri possit, evolvisse; et cum fide et judicio librato examinasse. Ac primo sane dubium non esse, quin si opiniones eorum in propriis extarent operibus, majorem firmitudinem habituræ fuissent; cum Theoriarum vires in apta et se mutuo sustinente partium harmonia, et quadam in orbem demonstratione consistant, ideoque per partes traditæ infirmæ sint: quare non contemptim de illis judicium fecisse. Reperisse etiam inter placita tam varia, haud pauca in observatione naturæ et causarum assignatione non indiligenter notata; alios autem in aliis (ut fere fieri solet) fœliciores fuisse. Tantummodo Pythagoræ inventa et placita (licet numeri ejus quiddam physicum innuant) talia majore ex parte fuisse, quæ ad ordinem potius quendam religiosorum fundandum, quam ad scholam in philosophia aperiendam pertinerent; quod et eventus comprobavit; nam eandem disciplinam plus in hæresi Manichæorum, et superstitione Mahumeti, quam apud Philosophos valuisse. Reliquos vero, physicos certe fuisse; atque ex iis nonnullos, qui Aristotele longe et altius et acutius in naturam penetraverint. Atque illum scilicet Ottomanorum more in fratribus trucidandis occupatum fuisse; quod et ei ex voto successit; verum et de Aristotele, et reliquis istis Græcis non dissimile judicium fecit; Esse nimirum hujusmodi placita ac theorias veluti diversa diversarum fabularum

[1] *ac.* — G. [2] *ut.* — G. [3] *a Platone vel Cicerone.* — G.

in Theatro argumenta, in quandam veri similitudinem, alia elegantius alia negligentius aut crassius conficta; atque habere quod fabularum proprium est, ut veris narrationibus concinniora et commodiora videantur. Neque in istis tantum exhibitis et publicatis theoriis, humani ingenii peregrinationes et errores se sistere aut finire[1] potuisse. Nisi enim mores hominum et affectus et rerum civilium inclinationes hujusmodi novitatibus (etiam in contemplativis) adversæ et infensæ extitissent; dubium minime esse, quin et aliæ multæ in naturali philosophia sectæ introductæ fuissent. Quemadmodum enim in Astronomicis, et iis quibus terram rotari placet, et iis qui per eccentricos et epicyclos motus expediunt, eorum quæ in cœlis sub sensu apparent patrocinia et advocationes æquæ et ancipites sunt; quin et tabularum calculi utrisque respondent; eodem modo et multo etiam facilius esse in Naturali Philosophia complures theorias excogitare, longe inter se ad invicem differentes, sed tamen singulas sibi constantes, et instantiarum vulgarium (quæ in ejusmodi quæstionibus judicia exercere solent) suffragatione abutentes, atque in diversa trahentes. Neque enim defuisse, qui nostra et patrum ætate novas Philosophiæ Naturalis fabricas meditati sunt: Nam Telesium nostra memoria scenam conscendisse, et novam fabulam egisse, magis argumento probabilem quam plausu celebrem:[2] et Fracastorium, non ita pridem, licet novam sectam non elegerit, tamen libertate judicii et inquisitionis honestissime usum esse. Cardanum etiam non minus ausum; sed leviorem. Quin et nuper Gilbertum nostratem, cum naturam Magnetis laborio-

[1] *finiri.* — G. The last letter has been corrected in the MS.; but whether from *e* into *i* or from *i* into *e* I cannot confidently say.

[2] Telesius is here spoken of more favourably than in the *Temporis Partus Masculus*. The phrase *plausu celebrem* occurs in both passages.

sissime et magna judicii firmitudine et constantia, necnon experimentorum magno comitatu et fere agmine perscrutatus esset, statim novæ in Philosophia Naturali sectæ imminere cœpisse;[1] nec Xenophanis nomen in ludibrium versum expavisse, in cujus sententiam inclinabat.[2] Hos itaque, et si qui sunt aut erunt horum similes, antiquorum turbæ aggregandos; unam enim eandemque omnium rationem haberi. Esse nimirum homines secundum pauca pronuntiantes, et naturam leviter attingentes, nec ita se illi immiscentes ut aut contemplationum veritatem aut operum utilitatem assequi possint. Credere enim ex tot Philosophiis per tot annorum spatia laboratis[3] et cultis, ne unum quidem experimentum adduci posse, quod ad hominum statum levandum aut locupletandum spectet, et hujusmodi speculationibus vere acceptum referri possit. Quin contra Aristotelis de quatuor elementis commentum, cui ipse potius authoritatem quam principium dedit (quod avide a Medicis acceptum, quatuor complexionum, quatuor humorum, et quatuor primarum qualitatum conjugationes post se traxit) tanquam malignum aliquod et infaustum sidus, infinitam et Medicinæ necnon compluribus Mechanicis rebus sterilitatem attulisse; dum homines per hujusmodi concinnitates et compendiosas ineptias sibi satisfieri patientes, nil amplius curant. Quæstionum interim et controversiarum turbas circa hujusmodi Philosophias undique sonare et volitare; adeo ut fabula illa de Scylla in eas ad vivum competere videatur; quæ virginis os et vultum extulit; ad uterum

[1] It seems from this that Gilbert's posthumous work, *Physiologia Nova*, published in 1653 by Gruter, but which Bacon had certainly seen in manuscript, was written after the treatise *De Magnete*, published in 1600.

[2] See Vol. III. p. 374. note 2.

[3] *elaboratis*. — G.

vero monstra latrantia succingebantur et adhærebant: ita habere et istas doctrinas quædam primo aspectu speciosa, sed cum ad partes generationis ventum sit,[1] ut fructum ex se edant, tum nil præter lites et inquietas disputationes inveniri, quæ partus vicem obtineant. Atque illud interim notandum, quæ de placitorum rejectione dicta sunt, opinionibus tantum, non ingeniis authorum aut laboribus derogare. Quanto enim quis ingenio et studio maxime valeat, eundem, si naturæ lucem et historiam et rerum particularium evidentiam deserat, tanto magis in obscuriores et magis perplexos phantasiarum et Idolorum recessus et quasi specus se detrudere et involvere. Neque insuper, generales philosophiarum theorias ita[2] argui, ut particulares et inferiorum causarum assignationes, quæ in hujusmodi philosophorum operibus reddi et quæri solent, probentur: verum et has nihilo illis meliores esse; non tantum quod ab illis pendeant, sed quod et ipsæ nullam inquisitionis severitatem[3] præ se ferant; ad paulo notiora et fere obvia deducentes, in quibus mens humana leviter acquiescat et sibi complaceat; verum ad interiora Naturæ minime penetrantes; atque hoc vitii (quod omnium instar est) semper habentes; ut experimenta et effecta jam nota, cohærentia quadam et veluti reticulo connectant, ad eorum quæ nota sunt justam mensuram facto: sed neutiquam causam aliquam aut regulam demonstrent, quæ nova nec prius cognita effecta aut experimenta designet. Atque post has philosophiarum oras peragratas, se undique circumspicientem etiam ad antiquitatis penetralia oculos conjecisse, veluti versus tractum quendam nubilosum et obscurum. Atque scire se, si minus sincera fide agere vellet, non difficile

[1] *ventum est.* — G. [2] *ita* om. G. [3] *severitatem inquisitionis.* — G.

esse hominibus persuadere, apud antiquos sapientes, diu ante Græcorum tempora, Scientiam de Natura majore virtute, sed majore etiam fortasse silentio floruisse: atque ideo solennius fore ea quæ jam afferuntur ad illa referre; ut novi homines solent, qui nobilitatem antiquæ alicujus prosapiæ per Genealogiarum rumores et conjecturas sibi affingunt: sed se, rerum evidentia fretum, omnis imposturæ conditionem recusasse; et qualemcunque ipse opinionem de illis sæculis habeat, tamen ad id quod agitur non plus interesse putare, utrum quæ jam invenientur antiquis cognita et per rerum vicissitudines occidentia et orientia sint, quam hominibus curæ esse debere, utrum Novus Orbis fuerit Insula illa Atlantis et veteri mundo cognita, an nunc primum reperta. Rerum enim Inventionem a Naturæ luce petendam, non ab antiquitatis tenebris repetendam esse. Interea venire alicui in mentem posse, de Chimistarum arte sive philosophia taceri: quod se honoris causa fecisse; quia eam [1] cum illis philosophiis quæ prorsus operum effœtæ sint conjungere noluerit; cum ipsa inventa utilia [2] non pauca exhibuerit et donarit. Verum fabulam illam in hanc artem non male congruere, de sene qui filiis aurum in vinea defossum (nec satis scire quo loco) legaverit; unde illos ad vineam diligenter fodiendam versos esse, et aurum quidem nullum repertum, sed vindemiam ea cultura factam uberiorem. Simili modo et Chimiæ filios, dum aurum (sive vere sive secus) defossum invenire satagunt, movendo et experiendo haud parvo proventui hominibus et utilitati fuisse. Sed illorum inventa non alio modo, nec ratione aliqua meliore, quam artium Mechanicarum, principia et incrementa cepisse; [3]

[1] *eam* om. G. [2] *nobilia.* G.
[3] *cæpisse* in MS. and also in Gruter.

id est, per experientiam meram. Nam philosophiam et speculativam eorum rem minus sanam esse; et illis de quibus locuti jam sumus philosophiarum fabulis duriorem. Utcunque enim Principiorum Trias inventum non inutile fuerit, sed rebus aliqua ex parte finitimum; tamen maxima ex parte, eos paucis distillationum experimentis assuetos, omnia in Philosophia ad separationes et liberationes retulisse, verarum alterationum oblitos. Illam autem opinionis fabricam, qua veluti basi philosophia eorum[1] nititur; nempe esse quatuor rerum matrices sive elementa, in quibus semina et species rerum fœtus suos absolvant, atque hæc quadriformia[2] esse, pro differentia nimirum cujusque elementi; adeo ut in cœlo, aëre, aqua, terra, nil[3] inveniatur, quod non habeat in tribus reliquis conjugatum aliquod et quasi[4] parallelum:[5] huic certe phantasticæ rerum naturalium phalangi peritum Naturæ contemplatorem vix inter somnia sua locum daturum. Neque dissimiles esse rerum harmonias, quæ Naturalis Magiæ cultoribus placuerunt; qui et ipsi per rerum Sympathias et Antipathias omnia expediunt; et ex otiosis et supinissimis conjecturis, rebus virtutes et operationes admirabiles affingunt.[6] Verum et his[7] se parcere; quod inter tot fabulas, tamen opera aliquando exhibent:[8] licet ea fere hujusmodi sint, ut ad admirationem et novitatem, non ad fructum et utilitatem accommodata sint. Sed tamen et novitatis hunc usum plerumque esse; ut sinus naturæ nonnihil excutiat, et luce potius quam[9] actu juvet. Quare

[1] *eorum philosophia.* — G.

[2] *quadriforma* in MS.: a transcriber's error no doubt, which Bacon had overlooked.

[3] *nihil.* — G. [4] *quasi* om. G.

[5] See the note 2. p. 22.

[6] See the first book of Porta's Natural Magic.

[7] *iis.* — G. [8] *exhibeant.* — G. [9] *luce saltem, si minus actu.* — G.

visum est ei, neque in Græcorum, neque in novorum hominum placitis, neque in Alchimiæ aut Naturalis Magiæ traditionibus aliquid inveniri, quod ad opes humanas majorem in modum augendas spectet. Itaque hæc omnia vel oblivioni devovenda esse, vel popularibus studiis permittenda, dum veri Scientiarum filii alio cursum dirigant.

Cogitavit et illud; etiam de demonstrationum modis videndum. Demonstrationes enim potentia quadam Philosophiam esse: atque prout illæ aut rectæ aut pravæ sint, inde doctrinas perfectas aut imperfectas sequi probabile esse. Comperit autem, Demonstrationes quæ in usu sunt, nec plenas nec fidas esse. Neque tamen sensibus derogandum, quod quidam fecerunt. Sensuum enim errores in singulis, ad summam Scientiarum non multum facere; quin et ab intellectu fidelius informato corrigi posse. Sed Intellectum ipsum Natura sola fretum, sine arte et disciplina rebus imparem et minorem, sine cunctatione pronuntiandum. Neque enim aut ita capacem esse, ut omnigenam particularium supellectilem ad informationem necessariam recipiat et disponat; neque ita vacuum et purum, ut rerum imagines veras et nativas, absque phantasia et tinctura, admittat. Quin certissimum esse, tum generaliter mentem humanam instar speculi inæqualis esse, quæ rerum radios secundum propriæ sectionis angulos, et non in superficie plana suscipiat et reflectat: tum etiam cuique ex educatione, studiis, et natura sua, vim quandam seductoriam et quasi dæmonem familiarem adesse, qui mentem variis et vanis spectris ludat et turbet. Neque propterea ad opinionem Acatalepsiæ deveniendum. Cuilibet enim manifestum esse, nulla manus constantia, nec oculorum judicio maxime exquisito, lineam rectam

vel circulum perfectum describi posse. Attamen admota regula, aut circino circumducto, rem præsto esse. Atque in Mechanicis, manus hominum nudas ad quantula opera sufficere? easdem vi et ope instrumentorum, vastissima quæque ac rursus subtilissima vincere. Sequi igitur, ut ad artem confugiendum, et de demonstratione, quæ per artem regitur, videndum sit. Atque de Syllogismo, qui[1] Aristoteli oraculi loco est, paucis sententiam claudendam. Rem esse nimirum, in doctrinis quæ in opinionibus hominum positæ sunt, veluti moralibus et politicis, utilem et intellectui manum quandam auxiliarem; rerum vero naturalium subtilitati et obscuritati imparem et plane[2] incompetentem. Nam Syllogismum certe ex propositionibus constare, propositiones ex verbis, verba notionum sive animi conceptuum tesseras[3] et signacula esse. Quamobrem notiones ipsæ, quæ verborum animæ sunt, si vagæ, nesciæ, nec satis definitæ fuerint (quod in naturalibus longe maxima ex parte fieri consuevit), omnia ruere. Restare Inductionem, tanquam ultimum et unicum rebus subsidium et perfugium: neque immerito in ea spes sitas esse, ut quæ opera laboriosa et fida rerum suffragia colligere et ad intellectum perferre possit. Verum et hujus nomen tantummodo notum esse; vim et usum homines hactenus latuisse. De Inductione enim ita decernendum. In usu ejus atque etiam forma homines dupliciter peccasse. Primo quod moræ impatientes, et compendia viarum undique lustrantes, et quædam in certo ponere, circa quæ tanquam circa polos disputationes verterentur, properantes; eam tantum ad generalia Scientiarum principia adhibuerunt, media per Syllogismorum derivationes expedire temere sperantes. Rursus, quod de

[1] So Gruter; *quod* in MS. [2] *plane* om. G. [3] *testes*. — G.

Syllogismo accurate, de hac autem demonstratione cursim et negligenter inquirentes, formam ejusdem meditati sunt admodum simplicem et plane puerilem; quæ per enumerationem tantum procedat, atque propterea precario, non necessario concludat. Itaque cum circa demonstrationes talia cogitet, mirum nemini videri posse, si in philosophia naturali sibi cum aliis, sive veteribus sive novis, non conveniat. Neque enim fieri posse (quod ille [1] per jocum dixit) ut idem sentiant, qui aquam et qui vinum bibunt. Illos enim liquorem imbibere crudum, et ex intellectu vel sponte manantem vel industria quadam haustum: se autem liquorem parare et propinare ex infinitis uvis, iisque maturis et tempestivis, et per racemos decerptis et collectis, et subinde in torculari pressis, et in vase repurgatis et clarificatis, constantem; qui tamen ab omni inebriandi qualitate rectificetur, cum nil prorsus phantasiarum vaporibus tribuat aut relinquat. Quare visum est ei, Philosophias illas quas jamdudum diximus, non tantum propter operum sterilitatem, sed etiam propter demonstrationum infirmitatem et fallacias rejici, cum non solum a rebus desertæ, sed et ab auxiliis quæ sibi paraverunt destitutæ ac proditæ sint.

Cogitavit et illud; etiam de inveniendi modis qui in usu sunt, separatim videndum, si modo aliqui sint. In hac enim parte non tam errores et devia, quam solitudinem et vacua inveniri; quod stupore quodam animum perculserit.[2] Non ulli mortalium cordi aut curæ fuisse, ut ingenii et intellectus humani vires ad artes et scientias inveniendas et promovendas dirigeret, eoque viam muniret; sed omnia vel traditionum caligini, vel argu-

[1] Philocrates of himself and Demosthenes.
[2] *perculerit.* — G.

mentorum vertigini[1] et turbini, vel casus et experientiæ undis et ambagibus, permissa esse et permitti. Itaque non sine causa fuisse, quod apud Ægyptios (qui rerum inventores more apud antiquitatem recepto consecrare solebant) tot brutorum effigies in templis reperirentur; cum animalia rationis expertia ex æquo fere cum hominibus Naturæ operationum Inventores fuerint. Neque ad hoc homines sua prærogativa hactenus[2] admodum usi sint:[3] sed tamen de iis quæ fiunt, videndum. Et primo de Inveniendi modo simplici et inartificioso, quod hominibus familiare est; id non aliud esse, quam ut is qui se ad inveniendum aliquid comparat et accingitur, primo quæ ab aliis circa illud dicta sint inquirat et evolvat; deinde meditationem propriam addat. Verum ut quis vel aliorum fidei se committat, vel spiritum suum solicitet et fere invocet ut sibi oracula pandat, rem prorsus sine fundamento esse. Sequi inventionem quæ apud Dialecticos recepta sit. Eam solummodo nomine tenus ad id quod agitur pertinere. Non enim principiorum et axiomatum esse, ex quibus artes constant, sed tantum eorum quæ illis consentanea videntur. Dialecticam enim magis curiosos et importunos et sibi negotium facessentes, ad fidem et veluti sacramentum cuilibet arti præstandum notissimo responso rejicere. Restare experientiam meram; quæ, si occurrit, casus, si quæsita sit, Experimentum nominatur. Atque hanc non aliud quam (quod aiunt) scopas dissolutas esse. Quin et eos qui in aliqua natura vel operatione per multam et erraticam quandam experimentorum variationem revelanda et in lucem educenda sedulo occupati sunt, aut attonitos stare, aut vertiginosos circumire, aliquando gestientes, aliquando confusos, atque semper

[1] *vestigiis.* — G. [2] *hactenus* om. G. [3] *sunt.* — G.

invenire quod ulterius quærant. Neque prorsus aliter fieri posse. Insciam enim et imperitam valde cogitationem esse, alicujus rei naturam in seipsa perscrutandi. Eandem enim naturam in aliis latentem, in aliis manifestam et quasi palpabilem esse; atque in illis admirationem, in his ne attentionem quidem movere: veluti eam corporum naturam quæ separationi resistit, in aquarum bullis rem sane subtilem et fere ingeniosam videri, quæ hujus rei gratia in pelliculas quasdam in hæmisphærii formam effictas se conjiciunt; eandem in ligno vel lapide non magnopere notari, sed solidi appellatione transmitti. Quare visum est ei, hominibus non tam ignorantiam quam infœlicitatem quandam imputari, cum a curriculo et via per infortunium aut blandimenta deflexerint, non in ejusdem spatiis minus se strenuos præstiterint.

Cogitavit et illud; finem aliquando desperationi, aut saltem querimoniis imponendum: ac illud potius videndum, an omnino cessandum et his [1] quæ habemus utendum sit, an aliquid ut in [2] melius res procedant tentandum et moliendum. Ac primum, finis ipsius et propositi meritum et pretium intueri par esse; ut in materia dura et opere arduo major fiat industriæ accensio. Veniebat autem ei in mentem, antiquis sæculis, Rerum Inventoribus (modum excedente hominum affectu et impetu) divinos honores attributos esse. Iis autem, qui in rebus Civilibus merebantur, quales erant Urbium et Imperiorum Conditores, Legislatores, Patriarum a diutinis malis liberatores, Tyrannidum debellatores, et his similes, intra heroum modum honores stetisse. Nec immerito hanc distinctionem priscis illis temporibus invaluisse, cum illorum beneficia ad universum genus

[1] *iis.* — G. [2] *in* om. G.

humanum, horum ad certas regiones et definitas hominum sedes pertinerent: illa insuper sine vi aut perturbatione humanam vitam bearent; hæc vero non absque tumultu et violentia fere introducta sint. Quod si particularis alicujus inventi utilitas ita homines affecerit, ut eum qui universum genus humanum unico aliquo beneficio complecti posset, homine majorem putarent; at multo celsius inventum esse, quod alia omnia inventa particularia potentia quadam in se contineat, ac animæ humanæ vias aperiat,[1] ut ad nova et ulteriora quæque ductu certo et recto penetrare possit. Quemadmodum enim sæculis prioribus, cum homines in navigando per stellarum tantum observationes cursum dirigebant, eos veteris sane continentis oras legisse, aut maria aliqua minora et mediterranea trajecisse; necesse autem fuisse usum acus nauticæ, ut ducem viæ magis fidum, innotuisse, antequam Oceanus trajiceretur, et Novi Orbis regiones detegerentur: simili prorsus ratione, quæ hucusque in artibus et scientiis hominum inventa sunt, potuisse instinctu, usu, observatione, meditatione, aperiri, utpote sensui propiora; antequam vero ad remotiora et occultiora naturæ appellere liceat, necessario præcedere, ut melior et perfectior mentis humanæ usus et adoperatio inveniatur. Quare hujuscemodi Inventum proculdubio Temporis partum nobilissimum, et vere masculum esse. Rursus in Scripturis Sacris notabat, Salomonem Regem, cum imperio, auro, magnificentia operum, satellitio, famulitio, servorum et ministrorum[2] pulcherrima descriptione et ordine, classe insuper, nominis claritudine, et summa hominum admiratione floreret; nil horum tamen sibi gloriæ duxisse; verum ita

[1] *animam humanam carceribus liberet, eique vias aperiat.* — G.
[2] *famulorum.* — G.

pronuntiasse: *Gloriam Dei esse rem celare, gloriam Regis autem rem invenire:* non aliter ac si divina natura innocenti et benevolo puerorum ludo delectaretur, qui ideo se abscondunt ut inveniantur; ac animam humanam sibi collusorem in hoc ludo, pro sua in homines indulgentia et bonitate optaverit. Atque hanc inveniendi gloriam eam esse, quæ humanam naturam nobilitet nec interim cuiquam mortalium molesta sit (ut Civilia esse solent), nec conscientiam in aliquo remoretur aut mordeat, sed omnino meritum et beneficium sine alicujus pernicie, injuria, aut tristitia deferat: Lucis enim naturam puram et absque maleficio esse; usum ejus perverti; ipsam non pollui. Rursus etiam hominum studia et ambitiones reputans, tria ambitionis genera reperiebat, si modo uni ex iis id nomen imponere fas sit; Primam eorum qui ad propriam potentiam in patriis suis amplificandam magna contentione feruntur; atque hanc vulgarem esse et degenerem: Secundam eorum qui patriæ suæ potentiam inter humanum genus provehere nituntur; quæ sane plus habet dignitatis, cupiditatis minus:[1] Tertiam eorum qui hominis ipsius sive humani generis potentiam et imperium in rerum universitatem instaurare et attollere conantur; quæ reliquis proculdubio et sanior est et augustior: Hominis autem imperium sola scientia constare: tantum enim potest quantum scit: neque ullas vires naturalium causarum catenam perfringere posse; Naturam enim non aliter quam parendo vinci. Cogitabat etiam et animo volvebat, qualia sint, quæ tam de vi simplici et mera inventorum quam de ea[2] quæ cum merito et beneficio conjuncta sit, cogitationem subire possunt. Ac illam

[1] *haud minus.* — G.

[2] *quæ de virtute ac vi inventorum, tam simplici et mera, tam ea.* — G.

quidem non in aliis manifestius occurrere, quam in tribus illis Inventis, quæ et ipsa antiquis incognita, et quorum primordia etiam nobis obscura et ingloria sunt; Artis nimirum Imprimendi, Pulveris Tormentarii, et Acus Nauticæ. Hæc enim tria, numero scilicet pauca ac inventu non multum devia, rerum faciem et statum in orbe terrarum mutasse: primum in re literaria, secundum in re bellica, tertium in re navali; unde infinitas rerum mutationes secutas esse, attentius intuentibus conspicuas; ut non [1] imperium aliquod, non secta, non stella majorem efficaciam et quasi influxum in res humanas habuisse videatur, quam ista mechanica habuerunt. Quod autem ad merita attinet, id optime percipi, si quis consideret quantum intersit inter hominum vitam in excultissima aliqua Europæ provincia, et in regione aliqua novæ Indiæ maxime fera et barbara; tantum sane ut merito hominem homini Deum esse, non solum ex auxilio et beneficio, sed ex status comparatione dici possit. Atque hoc non solum, non cœlum, non corpora, sed Artes præstare. At non novum orbem scientiarum et novum orbem terrarum in eo conventuros, ut vetera novis sint longe cultiora. Quin contra necesse esse, accessiones artium iis quæ jam habemus multo se ostendere præstantiores, ut quæ naturam non leviter inflectere, sed vincere et subigere et in imis fundamentis concutere possint; fere enim perpetuo fieri, ut quod inventu sit obvium, id opere sit infirmum; cum radices demum rerum virtute validæ, eædem situ abditæ sint. Si quis autem sit, cui in contemplationis amorem et venerationem effuso, ista operum frequens et cum tanto honore mentio quiddam asperum et ingratum sonet, is pro certo sciat, se pro-

[1] Here a leaf of the MS. has been lost.

priis desideriis adversari; etenim in natura, opera non tantum vitæ beneficia, sed et veritatis pignora esse. Et quod in religione verissime requiritur, ut fidem quis ex operibus monstret; idem in naturali philosophia competere, ut scientia similiter ex operibus monstretur. Veritatem enim per operum indicationem, magis quam ex argumentatione aut etiam ex sensu, et patefieri et probari. Quare unam eandemque rationem et conditionis humanæ et mentis dotandæ esse. Itaque visum est ei, quæ de finis quem animo metimur et destinamus dignitate dicta sunt, ea non verbis in majus aucta, sed vero minora esse.

Cogitavit et illud; quæ de finis excellentia dicta sunt, posse votis similia videri. Itaque videndum sedulo, quid spei affulgeat, et ex qua parte se ostendat: ac curandum, ne rei optimæ ac pulcherrimæ amore capti, severitatem judicii amittamus aut minuamus. Consentaneum enim esse, prudentiam civilem in hac parte adhibere, quæ ex præscripto diffidit, et de humanis in deterius conjicit. Leviores igitur spei auras rejiciendas: eas autem quæ aliquid firmitudinis habere videntur discutiendas. Atque auguria rite capienti, primo illud occurrebat, hoc quod agitur, ob boni naturam eminentem, manifeste a Deo esse; atque in operibus divinis tenuissima quæque[1] principia eventum trahere. Etiam ex natura temporis bene ominabatur: omnium enim consensu veritatem Temporis filiam esse. Summæ igitur infirmitatis[2] esse, authoribus infinita tribuere, authori autem authorum, atque omnis authoritatis, Tempori, jus suum denegare. Neque solum de Temporis communi jure, sed et de nostræ ætatis

[1] Here we recover the MS. again.
[2] *infirmitatis et pusillanimitatis.* — G.

prærogativa bene sperabat. Opinionem enim quam homines de Antiquitate fovent negligentem esse, ac vix verbo ipsi congruam. Antiquitatem enim proprie dici, Mundi ipsius senium, aut ætatem provectiorem. Atque revera consentaneum esse, quemadmodum majorem rerum humanarum notitiam et maturius judicium ab homine sene expetamus quam a juvene, ob experientiam, et eorum quæ vidit et audivit et cogitavit multitudinem: eodem modo, et a nostra ætate (si vires suas nosset, et experiri et intendere vellet) majora quam a priscis temporibus sperari par esse; utpote ætate mundi grandiore, et infinitis experimentis et observationibus cumulata et aucta. Neque pro nihilo æstimandum, quod per longinquas illas navigationes et peregrinationes quæ nostra ætate increbuerunt, plurima in natura patuerunt quæ novam philosophiæ lucem affundere possint. Quin et turpe hominibus esse, si Globi Materialis tractus, terrarum videlicet, marium, astrorum, nostris temporibus in immensum aperti et illustrati sint; Globi autem Intellectualis fines intra veterum inventa et angustias steterint. Etiam Temporum conditionem in Europa, civilium rerum respectu non alienam esse; aucta Anglia, pacata Gallia, lassata Hispania,[1] immota Italia et Germania: Itaque libratis regum maximorum potentiis, et inconcusso[2] nationum nobilissimarum statu, res ad pacem, quæ Scientiis instar tempestatis serenæ et benignæ est, inclinare. Neque ipsum rei literariæ statum hisce temporibus incommodum esse: sed et quandam opportunitatem præ

[1] The *Cogitata et Visa* was written in 1607, only two years before the struggle between Spain and the United Provinces was terminated by the Great Truce. It is to this contest that the epithet *lassata* apparently refers.

[2] *incusso*. — G.

se ferre; tum ob Imprimendi artem, antiquis incognitam, cujus beneficio singulorum inventa et cogitata fulguris modo transcurrere queant; tum ob religionis controversias, quarum tædio fortasse homines ad Dei potestatem, sapientiam, et bonitatem in operibus suis contemplandum facilius animum adjicere possint. Si quis autem sit, qui consensu et temporis diuturnitate in veterum placitis moveatur, is si in res acutius introspiciat, ductores admodum paucos, reliquos sectatores tantum et plane[1] numerum esse reperiet; homines nimirum, qui ab ignorantia ad præjudicium transierunt, neque in verum consensum (qui interposito judicio fit) unquam coïerunt. Atque ipsam temporis diuturnitatem recte consideranti in angustias parvas redigi. Nam ex viginti quinque annorum centuriis, in quibus memoria hominum fere versatur, vix quinque centurias seponi, quæ scientiarum proventui utiles et feraces fuerint; easque ipsas longe maxima ex parte aliis scientiis, non illa de natura, satas et cultas fuisse. Tres enim doctrinarum revolutiones et periodos numerari: unam apud Græcos; alteram apud Romanos; ultimam apud occidentales Europæ nationes: reliqua mundi tempora bellis et aliis studiis occupata, et quoad scientiarum segetem sterilia et vasta inveniri. Atque de tempore sic cogitabat. Etiam ex casus vi et natura hujusmodi divinationem sumpsit. Casum nimirum proculdubio multis Inventis principium dedisse, sumpta ex natura rerum occasione. Nam[2] ideo in ignis invento Prometheum novæ Indiæ ab Europæo dissensisse, quod

[1] *plane* om. G.

[2] *Num.* — G. This was no doubt a mere misprint; but modern editors have turned it into a false reading, by inserting after *copia* a note of interrogation, which is not found in Gruter.

apud eos silicis non est copia. Itaque in his quæ præsto sunt, casum largius inventa exhibere; in iis quæ ab usu quotidiano semota sunt, parcius; sed utcunque, omnibus sæculis parturire et parere. Neque enim causam videri, cur casus consenuisse putetur, aut effœtus jam factus. Igitur ita cogitabat, si hominibus non quærentibus et aliud agentibus multa inventa occurrant, nemini sane dubium esse posse, quin eisdem quærentibus, idque via et ordine, non impetu et desultorie, longe plura detegi necesse sit. Licet enim semel aut iterum accidere possit, ut quispiam in id forte fortuna incidat quod magno conatu scrutantem antea fugit, tamen in summa rerum proculdubio contrarium inveniri. Casum enim operari raro, et sero, et sparsim; Artem contra constanter, et compendio, et turmatim. Etiam ex inventis ipsis quæ jam in lucem prodita sunt, de iis quæ adhuc latent conjecturam rectissime capi putabat. Eorum autem nonnulla ejus esse generis, ut antequam invenirentur haud facile cuiquam in mentem venisset de iis aliquid suspicari. Solere enim homines de novis rebus ad exemplum veterum, et ad phantasiam ex iis præceptam hariolari: quod opinandi genus fallacissimum est; quandoquidem ea quæ ex rerum fontibus petuntur, per rivulos consuetos non utique fluunt. Veluti si quis, ante tormentorum igneorum inventionem, rem per effectus descripsisset, atque ita dixisset, Inventum quoddam detectum esse, per quod muri et munitiones quæque maximæ ex longo intervallo quaterentur et dejicerentur; homines sane de viribus tormentorum et machinarum per pondera et rotas et similia multiplicandis, multa et varia commentaturos fuisse; de vento autem igneo vix unquam imaginationem aliquam occursuram fuisse; ut cujus exemplum

non vidissent, nisi forte in terræ motu aut fulmine, quæ ut non imitabilia rejecissent. Eodem modo si ante fili bombycini inventionem quispiam hujusmodi sermonem injecisset: Esse quoddam fili genus ad vestium et supellectilis usum, quod filum lineum aut laneum longe tenuitate ac nihilominus tenacitate ac etiam splendore et mollitie excelleret, homines statim aut de serico aliquo vegetabili, aut de alicujus animalis pilis delicatioribus, aut de avium plumis et lanugine, aliquid opinaturos fuisse: de vermis autem alicujus textura, eaque tam copiosa et anniversaria, nil cogitaturos: quod si quis etiam de vermi verbum aliquod emisisset, ludibrio certe futurum fuisse; ut qui novas aranearum operas somniaret. Quare eandem et eorum quæ in sinu naturæ adhuc recondita sunt magna ex parte rationem esse, ut hominum imaginationes et commentationes fugiant et fallant. Itaque sic cogitabat; si cujus spem de novis inventis cohibeat, quod sumpta ex his quæ præsto sunt conjectura, ea aut impossibilia aut minus verisimilia putet; eum scire debere se non satis doctum ne ad optandum quidem commode et apposite esse. Sed rursus cogitabat, esse ex jam inventis alia diversæ et fere contrariæ naturæ, quæ fidem faciant, posse genus humanum nobilia inventa etiam ante pedes posita præterire et transmittere. Utcunque enim pulveris tormentarii, vel fili bombycini, vel acus nauticæ, vel sacchari, vel vitri,[1] vel similium inventa occultis (ut existimantur) rerum proprietatibus[2] niti videantur; Imprimendi certe artem nihil habere, quod non sit apertum et fere obvium, et ex antea notis conflatum. Solere autem mentem humanam, in hoc inventionis

[1] *vel vitri* om. G.

[2] *vel similia inventa quibusdam rerum et naturæ proprietatibus.* — G.

curriculo, tam lævam et male compositam esse, ut in nonnullis primo diffidat, et non multo post se contemnat: atque primo incredibile videri, aliquid tale inveniri posse; postquam autem inventum sit, rursus incredibile videri, id homines tam diu fugere potuisse. Atque hoc ipsum quoque ad spem trahebat, superesse nimirum adhuc magnum inventorum cumulum, qui non solum ex operationibus incognitis eruendis, sed et ex jam cognitis transferendis et applicandis deduci possit. Etiam illa auspicia ut bona et læta accepit, quæ in artibus Mechanicis observavit, atque eorum successu, præsertim ad philosophiam comparato. Artes enim Mechanicas, ut auræ cujusdam vitalis participes, quotidie crescere et perfici; Philosophiam vero statuæ more adorari et celebrari, nec moveri. Atque illas in primis authoribus rudes et fere informes ac onerosas se ostendere: postea novas vires et commoditates adipisci. Hanc autem in primo quoque authore maxime vigere, ac deinceps declinare. Neque aliam hujus contrarii successus causam veriorem esse, quam quod in Mechanicis multorum ingenia in unum coëunt; in Philosophia autem, singulorum ingenia ab uno quopiam destruuntur. Nam postquam deditii facti sunt, amplitudinem non addere; sed in uno ornando aut stipando servili officio occupari. Quare omnem philosophiam ab experientiæ radicibus ex quibus primum pullulavit et incrementum cepit avulsam, rem mortuam esse. Atque hac cogitatione arrectus, etiam illud notavit; facultates Artium et Scientiarum aut Empiricas, aut Rationales sive Philosophicas, omnium consensu esse: has autem geminas [1]

[1] *geminas* om. G. Nor was this word in the MS. originally: it is inserted between the lines in Bacon's hand.

se non bene adhuc commistas[1] et copulatas videre. Empiricos enim formicæ more congerere tantum et uti; Rationales autem aranearum more telas ex se conficere. Apis vero rationem mediam esse, quæ materiam ex floribus tam horti quam agri eliciat, sed eam etiam propria facultate vertat et digerat. Neque absimile veræ Philosophiæ opificium esse; quæ ex Historia naturali et mechanicis experimentis præbitam materiam, non in memoria integram, sed in intellectu mutatam et subactam reponit. Neque se nescire, esse ex Empiricorum numero, qui se non mere Empiricos haberi volunt; et ex Dogmaticis, qui se in experientia industrios et perspicaces videri ambiunt: verum hæc fuisse et esse quorundam hominum artificia, existimationem quandam, ut alteruter in sua secta excellere videatur, captantium. Revera autem harum facultatum divortia et fere odia, semper valuisse. Quare ex arctiore earum et sanctiore fœdere omnia fausta et fœlicia portendi putabat. Etiam illud libenter vidit: Intuebatur nempe infinitas ingenii, temporis, facultatum expensas, quas homines in rebus et studiis (si quis vere judicet) inutilibus collocant; quarum pars quota si ad sana et solida verteretur, nullam non difficultatem superare posset. Neque esse quod homines particularium multitudinem reformident, cum Artium phænomena manipuli instar sint, ad ingenii commenta semel ab evidentia rerum disjuncta et distracta. Atque hæc quæ dicta sunt singula, impulsum quendam ad spem faciendam habere. Ante omnia autem certissimam spem esse, ex præteriti temporis erroribus; atque (quod[2] quispiam de civili statu non prudenter administrato dixit) *quod ad præterita spectando pessi-*

[1] *commissas.* — G. [2] *quod etiam.* — G.

mum, id[1] *ad futura optimum esse.* Cessantibus enim hujusmodi erroribus (ad quod ipsa monita primum gradum præstant) maximam rerum conversionem fore. Quod si homines per tanta annorum spatia viam tenuissent, nec tamen ulterius progredi potuissent, ne spem quidem ullam subesse potuisse. Tunc enim manifestum fuisse, difficultatem in materia et subjecto (quæ nostræ potestatis non sunt), non instrumento (quod penes nos est) ; hoc est, in rebus ipsis earumque obscuritate, non in animo humano et ejus adoperatione esse. Nunc autem apparere, viam non aliqua mole aut strue imperviam, sed ab humanis vestigiis deviam esse : itaque solitudinis metum paulisper offundere, nec ultra minari. Postremo et illud statuit, si spei multo imbecillior et obscurior aura ab isto novo continente spiraverit, tamen experiundum fuisse. Non enim pari periculo rem non tentari, et non succedere : cum in illo ingentis boni, in hoc pusillæ humanæ operæ jactura vertatur. Verum ex[2] dictis et non dictis visum est ei, spei abunde esse, non tantum homini industrio ad experiendum, sed etiam prudenti et sobrio ad credendum.

Cogitavit et illud ; studio accenso et spe facta, de modis perficiendi videndum esse. Hæc itaque sunt, quæ ei circa hoc generaliter visa sunt ; quæ etiam nudis et apertis sententiis claudere et complecti consentaneum putavit. Visum est ei, plane ab iis quæ jam facta sunt diversa facienda ; itaque rerum præteritarum redargutionem ad futura vice oraculi fungi. Visum est ei, theorias et opiniones et notiones communes, quantum rigore mentis et constantia obtineri potest, penitus aboleri ; et Intellectum planum et æquum ad particularia de integro accedere : ut fere non alius ad regnum na-

[1] *id ipsum.* — G. [2] *et.* — G.

turæ, quam ad regnum cœlorum, pateat aditus; ad quod nemini nisi sub persona Infantis ingredi liceat. Visum est ei, particularium sylvam et materiem, et numero et genere et certitudine aut subtilitate ad informationem sufficientem, colligi et congeri, tum ex naturali historia, tum ex experimentis mechanicis; atque ex his[1] potissimum, quia natura plenius se prodit cum ab arte tenetur et urgetur, quam in libertate propria. Visum est ei, eandem materiam ea ratione in Tabulas atque in ordinem redigi et digeri, ut Intellectus in eam agere, atque opus suum exequi possit; cum nec verbum divinum in rerum massam absque ordine operatum sit. Visum est ei,[2] a particularibus in Tabulas relatis, ad novorum particularium inquisitionem minime confestim transeundum (quod tamen et ipsum res utilis sit, et instar experientiæ cujusdam literatæ), sed ad generales et communes comprehensiones prius ascendendum.[3] Visum est ei, Intellectus motum et impetum naturalem, sed pravum, a particularibus ad comprehensiones supremas et generalissimas[4] (qualia sunt principia quæ vocant[5]) saliendi,[6] omnino cohibendum: sed comprehensiones proximas primo, ac deinceps medias, elicendas et inveniendas, atque per gradus continuos et scalam veram procedendum.[7] Visum est ei, talem inductionis formam inveniendam,[8] quæ ex aliquibus gen-

[1] *iis.* — G. [2] *ei* om. G.

[3] *procedendum, et naturali sane intellectus processui eatenus indulgendum. Sed simul visum est,* &c. — G.

[4] *superiores et magis generales.* — G.

[5] *principia quæ vocant artium et rerum.* — G.

[6] *saliendi. et reliqua descendendo per media expediendi.* — G.

[7] *adscendendum: fere enim contemplationum et intellectus vias in Bivium illud moralium, antiquis decantatum, coincidere: Alteram enim viam primo ingressu planam ad avia ducere, alteram a principio arduam et suspensam in plana desinere.* — G.

[8] *introduci.* — G.

eraliter concludat; ita ut instantiam contradictoriam inveniri non posse demonstretur.[1] Visum est ei, eam tantum comprehensionem probari et recipi, quæ non ad mensuram facta sit et aptata particularium ex quibus elicitur, sed amplior aut latior sit; eamque amplitudinem sive latitudinem suam ex novorum particularium designatione, quasi fidejussione quadam, firmet.[2] Visum est ei, multa præter hæc inveniri, quæ non tam ad perfectionem rei, quam ad operis compendium, ac etiam ad messem humanam inde accelerandam, insigniter faciant. Quæ omnia utrum recte cogitata sint an secus, ab opinionibus (si opus sit) provocandum, et effectis standum.

Cogitavit et illud; rem quam agit, non opinionem, sed opus esse; eamque non sectæ alicujus aut placiti, sed utilitatis et amplitudinis immensæ fundamenta jacere. Itaque de re non modo perficienda, sed et communicanda et tradenda (qua par est cura) cogitationem suspiciendam esse. Reperit autem homines in rerum scientia quam sibi videntur adepti, interdum proferenda, interdum occultanda, famæ et ostentationi servire: quin et eos potissimum qui minus solida proponunt, solere ea quæ afferunt obscura et ambigua luce venditare, ut facilius vanitati suæ velificare possint. Putare autem, se id tractare quod ambitione aliqua aut affectatione polluere minime dignum sit: sed tamen necessario eo decurrendum esse (nisi forte rerum et animorum valde imperitus esset, et non explorato[3]

[1] *ne forte secundum pauciora quam par est, et ex iis quæ præsto sunt pronuntiemus, et (quod unus ex antiquis dixit) scientiam in mundis propriis et non in mundo communi quæramus.* — G.

[2] *ne vel in jam notis hæreamus, vel laxiore fortasse complexu umbras et formas abstractas prensemus.* — G.

[3] *prorsus inexplorato.* — G.

viam inire vellet) ut satis meminerit, inveteratos semper errores, tanquam phreneticorum deliramenta, arte et ingenio subverti, vi et contentione efferari. Itaque prudentia ac morigeratione quadam utendum (quanta cum simplicitate et candore conjungi potest), ut contradictiones ante extinguantur quam excitentur. Ad hunc finem parare se de naturæ interpretatione atque de natura ipsa opus,[1] quod errores minima asperitate destruere, et ad hominum sensus non turbide accedere possit; quod et facilius fore, quod se non pro duce gesturus, sed ex natura ipsa lucem præbiturus et sparsurus sit, ut duce postea non sit opus. Sed cum tempus interea fugiat, et ipse rebus civilibus plus quam vellet immistus esset, id longum videri: præsertim cum incerta vitæ cogitaret, et aliquid in tuto collocare festinaret. Venit ei itaque in mentem, posse aliquid simplicius proponi, quod in vulgus non editum, saltem tamen ad rei tam salutaris abortum arcendum satis[2] esse possit. Atque diu et acriter rem cogitanti et perpendenti, ante omnia visum est ei, Tabulas Inveniendi, sive legitimæ Inquisitionis formulas[3] in aliquibus subjectis, proponi tanquam ad exemplum, et operis descriptionem fere visibilem. Neque enim aliud quicquam reperiri, quod aut vera viæ aut errorum devia in clariore luce ponere, aut ea quæ afferuntur nihil minus quam verba esse evidentius demonstrare possit: neque etiam quod magis fugiendum esset ab homine qui aut rei diffideret aut eam in magis accipi aut celebrari cuperet.[4] Tabulis

[1] *parare se de natura opus.* — G. [2] *satis fortasse.* — G.

[3] *hoc est materiem particularium ad opus intellectus ordinatam.* — G.

[4] The passage which follows, down to *edatur*, is not in Gruter's copy; and the next sentence runs thus: *Fieri autem posse ut si destinata perficere non detur, ut sunt humana tamen ingenia firmiora et sublimiora, etiam absque majoribus auxiliis, ab oblatis monita, reliqua ex se et sperare et potiri possint.*

autem propositis et visis, non ambigere quin timidiora ingenia subitura sit quædam hæsitatio et fere desperatio de similibus Tabulis in aliis materiis sive subjectis conficiendis; atque ita sibi in exemplo gratulaturos ut etiam præcepta desiderent. Plurimorum autem studia ad usum Tabularum supremum et ultimum, et clavem ipsam interpretationis poscendam arrecta fore: ac multo ardentius ad novam faciem naturæ saltem aliqua ex parte visendam, quæ per hujusmodi clavem resignata sit et in conspectum data. Verum sibi in animo esse, nec proprio nec aliorum desiderio servienti, sed rei conceptæ consulenti, Tabulis cum aliquibus communicatis, reliqua cohibere, donec tractatus qui ad populum pertinet edatur. Et tamen animo providere, ingenia firmiora et sublimiora, etiam absque majoribus auxiliis, ab oblatis monitos,[1] reliqua ex se et speraturos et potituros esse. Fere enim se in ea esse opinione, nempe (quod quispiam dixit) prudentibus hæc satis fore, imprudentibus autem ne plura quidem. Se nihilominus de cogitatis nil intermissurum. Quod autem ad tabulas ipsas attinet, visum est[2] nimis abruptum esse ut ab ipsis docendi initium sumatur. Itaque idonea quædam præfari oportuisse; quod et jam se fecisse arbitratur, nec universa quæ hucusque dicta sunt alio tendere.[3] Hoc insuper velle homines non latere, nullis inveniendi formulis (more nunc apud homines et artes recepto) necessitatem imponere; sed certe omnibus pertentatis, ex multo usu et nonnullo ut putat judicio, eam quam probavit et exhibuit inquirendi formulam verissimam at-

[1] So MS.

[2] *visum est autem.* — G. The words from *Se nihilominus* to *attinet* being omitted.

[3] The passage which follows, down to *adolescere*, is not in Gruter's copy; and the last sentence begins *Postremo visum est ei.*

que utilissimam esse. Nec tamen se officere quominus ii qui otio magis abundant, aut a difficultatibus quas primo experientem sequi necesse est liberi jam erunt, aut majoris etiam et altioris sunt ingenii, rem in potius perducant; nam et ipsum statuere, artem inveniendi proculdubio cum inventis adolescere. Ad extremum autem visum est ei, si quid in his quæ dicta sunt aut dicentur boni inveniatur, id tanquam adipem sacrificii Deo dicari, et hominibus, ad Dei similitudinem, sano affectu et charitate hominum bonum procurantibus.

FILUM LABYRINTHI;

SIVE

INQUISITIO LEGITIMA DE MOTU.

PREFACE

TO THE

INQUISITIO LEGITIMA DE MOTU.

By the last paragraph of the *Cogitata et Visa* we learn that that work was intended for a preface to certain "Tables of Discovery, or Formulæ of Legitimate Investigation," which were to be set forth in a few subjects as a specimen of the work in hand. *Ante omnia visum est ei Tabulas Inveniendi sive legitimæ inquisitionis formulas, hoc est materiem particularium ad opus intellectus ordinatam, in aliquibus subjectis proponi, tanquam ad exemplum et operis descriptionem fere visibilem.*

In the *Commentarius Solutus* (July 26. 1608), among other memoranda relating to the progress of the work, I find the following: "The finishing the 3 Tables, De Motu, De Calore et Frigore, De Sono."

Now in Gruter's volume, among the Impetus Philosophici, I find a Latin fragment entitled *Filum Labyrinthi, sive Inquisitio legitima de Motu;* in Stephens's second collection, I find an English piece entitled *Sequela chartarum, sive Inquisitio legitima de Calore et Frigore;* in Rawley's Opuscula I find a Latin fragment entitled *Historia et Inquisitio prima, de Sono et auditu, et de forma Soni, et latente processu Soni; sive Sylva Soni et auditus.*

Of these, the first is merely a skeleton of an enquiry, the titles of the several *chartæ* being given in order, but the titles only; the second is a rough collection of materials for that enquiry *de forma Calidi*, which was afterwards selected as the example to illustrate the method by, in the second book of the *Novum Organum;* both have evidently been intended as specimens of the *materies particularium ad opus intellectus ordinata*, and there can be little doubt that they belong properly to this period and place. The third is a collection of the *materies particularium*, set out without any indication of a tabular arrangement, and may perhaps have been drawn up in its present shape about the same time with those portions of the natural history which belong to the third part of the Instauration, and to which in form it bears a greater resemblance. But in the absence of all evidence from which the date of composition can be inferred, the reference in the *Commentarius Solutus* induces me to place it here.

The preface, entitled *Franciscus Bacon Lectori*, stands in Gruter's volume immediately before the *Filum Labyrinthi*, and probably belongs to it.

The selection of *Motion* as the first subject to which the new method was to be applied and the example by which it was to be illustrated, strikes me as very characteristic both of the aspiring genius of Bacon's philosophy and of the error of judgment which lay at the bottom of it. He saw that all the active operations of nature were modes of motion, and concluded that if we could thoroughly understand the nature of motion, we should at once have the key to her secret processes, and therewithal the command over her powers; which was the true end and aim of knowledge. The subtlety and

intricacy of the phenomena did not daunt him; for the true *method* was as the clue of the Labyrinth, which patiently and faithfully followed out must inevitably lead at last to the central principle which explains and reconciles them all. How far he proceeded in the enterprise, we may partly learn from the *Commentarius Solutus*, which contains the commencement of an elaborate and methodical investigation into the nature of motion; with what success, we may partly infer from the second book of the *Novum Organum*, in which the description of the different kinds of motion is introduced merely as a part of the doctrine of the prerogatives of instances: the fact probably being that he had despaired of arriving by the *Filum Labyrinthi* at any tangible result within any assignable time.

The investigation, as set down in the *Commentarius* on the 26th and 27th of July, 1608, is carried out a little further than in this fragment; and as it belongs naturally to this place, and will throw some additional light upon the nature of the process as Bacon at this time conceived it, as well as upon the names by which some of its stages are distinguished, I cannot better conclude this preface than by quoting it *in extenso*.

J. S.

Inquisitio Legitima.

Sectio ordinis.	Nov. op.	
		1. Carta electionis et præoptionis.
		2. Sylva, sive Carta Mater.
		3. Meta posita, sive Carta terminans.
		4. Loci, sive Carta Articulorum.
		5. Vena exterior, sive Carta divisionis primæ.

Ap. sc.[1] 6. Carta assignationis vel collocationis.

Sectio rerum. 7. 1. Carta Historiæ ordinatæ ad divisiones primas et reliquos articulos.

8. 2. Carta Amanuensis, sive super Instantias.

Sectio lucis. 9. 1. Carta Analysis motus compositi, vel de spelling.

10. 2. Vena interior, sive Carta divisionis secundæ.

11. 3. Carta observationis, sive axiomatis.

12. 4. Carta humana optativa.

13. 5. Carta humana activa, sive practica.

14. 6. Carta Anticipationis, sive interpretationis sylvestris.

15. 7. Carta Indicationis, sive ad cartas novellas.

Nota Interpretationem legitimam non fieri, nec clavem Interpretationis adoperari usque ad reordinationes et cartas novellas finitas, ut duæ sint machinæ Intellectus, una Inferior quam descripsimus, altera Superior quæ est novellarum.[2]

[1] Probably *apparentiæ secundæ*.

[2] This is the last of many memoranda which appear to have been transferred from an old note-book (transportata ex commentario vetere) on the 26th of July, 1608. The next page is headed *Transportat. Jul.* 27. 1608, — the beginning of the next morning's work.

Inquisitio Legitima de Motu.

Cart. electionis.

Quieta rerum principia sermones spectant; moventia autem et motus ipse, opera.

Motuum genera bene discreta et descripta, Protei vincula.

Meta posita.

Quod animo metimur; Motus; exacte inspicienti non alius quam localis; sensibilis scilicet et minutus.

Etiam quies comprehendatur; ex natura propria aut per accidens, ex libratione vel cohibitione motus.[1]

Tria motuum genera imperceptibilia, ob tarditatem, ut in digito horologii; ob minutias, ut liquor seu aqua corrumpitur aut congelatur &c.; ob tenuitatem, ut omnifaria aëris, venti, spiritus, quæ non cernuntur ac subtiliores eorum motus nullo sensu comprehenduntur, sed tantum per pensa et effectus.

Motus et naturas per globos non distinguimus ut alia sit ratio cœlestium, alia sublunarium: popularis ratio ista videtur et infirma; nam etiam cœlestia mutantur in magnis, ut patet in cometis coordinatis situ suo cum stellis fixis: In parvis si mutantur tamen sensum nostrum latent; Nam quæ etiam in superficie terræ fiunt mutationes de circulo Lunæ, si oculus ibi positus esset, discerni nequirent; Rursus eadem æternitas et motus regularitas terræ competit; Nam in profunditate terræ par æternitas ac in cœlo, et videntur variationes et mutationes et turbæ tantum in confiniis regnorum istorum fieri; scilicet in superficie et crusta terræ, et

[1] Opposite this paragraph is written *qu.*

superficie et confiniis cœli, et aëris regione media quam vocant; Etiam fluxus maris tam regularis est quam motus lunæ.

De motu autem animali, et de eo motu qui ad sensum peragendum requiritur, non inquirimus, sed eum sui juris facimus et emancipamus ut seorsim et principaliter inquiratur.

Motus autem animales quatenus ad cohibitionem et participationem manifestam motuum cæterorum comprehendimus, ut saltum, sanguinis per venas ascensionem, etc.

Motus autem impressionis sive signaturæ quæ incorporeæ sunt tamen ob spatiorum sive locorum Mutationes comprehendimus, ut in sonis, visibilibus, attractionibus sive coitionibus; calorem tamen et frigus omnino emancipamus ob dignitatem et multiplicem usum, et de illis seorsim et principaliter inquiri volumus.

Nec motum generationis vitalis expedimus, sive assimilationem magnam, sed et hunc emancipamus.

Carta Articulorum.

First to enquire the several kinds or diversities of motion.

Then what bodies or subjects are susceptible of every kind and what not, and what have them in strength and what more obscurely, and what have them more familiarly and what more rarely.

Then the comparisons of the forces of every motion, and which is predominant one over the other, and which is absolute and never falsified, if any such be; and how they evade and shift each nature of motion to do his part.[1]

[1] The last clause added in the margin.

Nodi et globi motuum, and how they concur and how they succeed and interchange in things most frequent.

The times and moments wherein motions work, and which is the more swift and which the more slow, and where they take their beginnings and where they leave.

The convenience or disconvenience which motion hath with heat and tenuity, and how these three meet, sever, and vary.

The power in motions corporal of agitation, fire, time.[1]

The effects of motion, and what qualities it induceth *respectivè* to every motion.

The force of union in motions, and the analogy thereof.[2]

Carta divisionis primæ, sive ad apparentiam primam.

Agitatio, sive Motus absque termino, sive Motus se exercens.

Latio, sive Motus ad terminum, sive Motus itinerans.

Agitationis species duæ: Agitatio placida; Agitatio inquieta.

Agitatio placida, sive Motus conversionis, sive *Curulis*.

Agitatio inquieta duplex: Agitatio relevationis et tentationis; Agitatio trepidationis.

[1] In the margin of the MS., opposite the last four paragraphs, are the following notes; written apparently at another time, and without any special reference to the particular paragraphs against which they happen to stand. They are written consecutively, one under the other, with strokes of the pen between to separate them. "The instruments and efficients. — Subjectum quasi efficiens generale, efficiens tanquam subjectum proximum. — Periodi et processus motuum. — Spatia orbis virtutis."

[2] This last article appears to have been added at another time.

Lationis species duæ: Latio manifesta, sive Motus localis; Latio occulta sive Motus corporalis.

Motus localis tres sunt species: Motus respectu spatiorum; Motus respectu situs partium; Motus respectu alterius.

Motus respectu spatiorum habet 4 species.
Motus nexus, sive ne detur Vacuum.
Motus plagæ, sive mechanicus, sive ne fiat penetratio dimensionum.
Motus libertatis, sive ad sphæram veterem, sive ad convenientiam; qui est duplex: Motus a violenta condensatione ad convenientiam raritatis; et Motus a violenta rarefactione ad convenientiam densitatis.
Motus hyles migrantis, sive ad sphæram novam; qui etiam est duplex: Motus hyles migrantis ad sphæram novam majorem; Motus hyles migrantis ad sphæram novam minorem.

Motus respectu situs partium est simplex, et est motus congruitatis sive disponens.

Motus respectu alterius habet 4 species.
Motus ad massam, sive congregationis major, sive Panegyricus sive fœderis generalis.
Motus Amicitiæ, sive congregationis minor; sive sympathiæ, sive fœderis sanctioris.
Motus disgregationis major, sive fugæ.
Motus disgregationis minor, sive Antipathiæ.

Motus corporalis habet species sequentes, numero 17.

Motus subsistentiæ, sive ne detur nihilum.
Motus integritatis, sive ne admittatur corpus externum; sive amplexus veteris.
Motus cohibitionis, sive regius, sive *ne admittatur nova forma.*
[Isti 3 motus pertinent ad conservationem in statu.[1]]

Motus maturationis; sive exaltationis et perfectionis naturæ suæ, sive in potius.
[Iste motus tendit ad perfectionem.[1]]
Motus contractionis, sive hyles minorans interius, sive restrictionis.
Motus relaxationis sive hyles majorans exterius, sive fusionis.
Motus separationis in se, sive factionis, sive congregans homogenea et disgregans heterogenea, sive unionis per partes.
[Isti 4 motus præsupponunt manentiam corporis in toto, absque jactura et emissione, licet mistura et ordinatio partium mutetur.[1]]

Motus separationis in aliud, sive exilii, sive exituræ aut emissionis.
Motus separationis altæ et magnæ, sive anarchiæ, sive putrefactionis, sive separationis in partes,[2] sive radicalis.
[Isti 3[3] motus pertinent ad separationem.]

Motus applicationis et resistentiæ secundum fibras, sive texturam et ordinem earum.

[1] Added in margin.
[2] I am sure that I read this word right.
[3] Sic.

Motus tenacitatis, sive adhærentiæ, sive primi tactus aut amplexus novi.

Motus receptionis in se, sive mistionis, sive incorporationis, sive indentatus, sive unionis per totum.

[Isti tres motus pertinent ad corporum applicationes.]

Motus generationis Jovialis, sive assimilationis, sive generationis similis sui fixæ et manentis.

Motus generationis Saturniæ, sive signaturæ aut impressionis, sive generationis similis sui momentaneæ vel transeuntis.

Motus generationis fictæ, sive excitationis et imitationis.

[Isti 3 motus pertinent ad propagationem speciei.]

Motus metamorphoseos placidæ, sive novæ formæ procedentis absque dissolutione.

Motus metamorphoseos destruentis, sive novæ formæ a corruptione, sive reordinationis et triumviratus, sive rudimenta generationis vitalis.

[Isti 2 motus sunt mutationis majoris.]

Carta assignationis.

Fractionem corporum, sive resistentiam contra fractionem et separationem, assignamus sub motu Integritatis.

Modum tamen fractionis in nonnullis aut prohibitionis fractionis in quo situs partium valet, assignamus sub motu applicationis primo.

Reductionem ad statum quo, as when urine or blood is broken and by fire reduced, assignamus sub motu cohibitionis vel regio.

Conservationem, mansionem in statu, non exituram spiritus in corporibus porosis sive terræ fixis (?) assignamus sub motu regio.

All ripenings, coction, assation, the gathering perfection of wines, beers, cyders, &c. by age and time, assignamus sub motu maturationis.[1]

Etiam multiplicationem virtutis per unionem quantitatis, vel conservationem status per unionem quantitatis, assignamus sub motu maturationis vel exaltationis.

Liquefactionem, Mollificationem, Liquiditatem, consistentiam, duritiem, indurationem, or closeness of parts, Ampliationem, congelationem, constipationem, assignamus sub motu hyles interiore.

Residence, flowering, working out a skin, defecation, refining, clearing and lees, dissolving or breaking as in blood or urine, coagulation or turning to curds or whey, hæc assignamus sub motu separationis in se.

[Etiam disordinationem partium, as when pears rolled get a sweetness, when roses crushed alter their smell, hæc assignamus motui separationis in se.]

Evaporationem, exhalationem, emissionem, consumptionem, diminutionem, arefactionem, assignamus sub motu separationis in aliud.

Corruptionem, rust, mould, assignamus motui separationis altæ.

Motus soliditatis sive expulsionis corporis dissimilis,

[1] The reference is to the three kinds of pepsis spoken of by Aristotle: pepansis, epsesis, and optesis. Meteorol. iv. — *R. L. E.*

et attractionem similis, assignamus sub motu mistionis.

Exuctionem, depastionem, deprædationem, intumescentiam, intenerationem, augmentationem, sive vegetatione seu accretione, assignamus motui generationis Jovis.

Fermentationem et infectionem assignamus generationi fictæ.

Destillationem, sublimationem, assignamus motui metamorphoseos placidæ.

Turning into worms, flies, &c., assignamus motui triumviratus.[1]

[1] Here a line is drawn across the page, and a different subject is entered upon, with a new pen and fresh fingers. The next page is headed *Transportata Jul.* 28. 1608. It would seem therefore that this concluded the day's work of Wednesday the 27th of July.

FRANCISCUS BACON LECTORI.

Si qui fuerint qui in veterum placitis sibi acquiescendum non putarunt, quod aliquando ab animi constantia, sæpius ab ingenii levitate fieri vidimus; ii qualescunque fuerint, hac fere defensione communi usi sunt; se, licet ab antiquitate desciverint, tamen ea afferre quæ cum sensu optime conveniant; atque homines, si hoc sibi in animum inducere possint ut authoritate non perstringantur sed sibi ipsi et sensibus credant, facile in eorum partes transituros. Nos vero sensum nec contradictione violavimus nec abstractione destruimus, et materiam ei longe uberiorem quam alii præbuimus, et multo ministerio errores ejus restituimus, potestates auximus, atque judicium ejus, damnatis phantasiis atque in ordinem redacta ratione, munivimus et firmavimus; ut alii professione quadam, nos reipsa sensum tueri videamur, atque philosophia nostra una fere atque eadem res sit cum sensu restituto et liberato. Neque propterea tamen nobis de hominum fide et assensu large pollicemur, cum nostra ratio cum nulla priorum consentiat, sed plane in diversum trahat. Nam qui hucusque, pertæsi eorum quæ veteres afferunt, ad experientiam et sensum tanquam de integro se contulerunt, in hunc modum fere se gesserunt; ut nonnulla primo secundum sensum acriter et strenue inquisiverint, ea potissimum sumentes quæ illis maxime rationem totius habere visa sunt; atque ex his confestim experientiæ

manipulis, et tanquam factionibus, placita confinxerint; anguste et inæqualiter philosophati, et omnia paucis condonantes. Atque iste tamen modus philosophandi ad fidem faciendam sæpenumero validus et felix est, ob angustias pectoris humani, quod illis quæ una et subito mentem subire possunt maxime movetur, et acquiescendi cupidum cætera vel negligit, vel modo quodam non perceptibili ita se habere putat ut illa pauca quibus phantasia impleri aut inflari consuevit. At contra, nos non manipulares, sed justum divinorum operum exercitum post nos trahentes, et ex æquo et secundum summas rerum pronunciantes, non habemus fere quo nos vertamus, aut ex qua parte aditum ad humanam fidem reperiamus; cum ea quæ adducimus altius quam notiones, latius quam hujusmodi experimenta, se extendant. Itaque necesse est ut ex illis pleraque præproperis et propensis sensuum prehensionibus non satisfaciant, nonnulla autem dura et instar religionis incredibilia ad sensus accedant. Sensus enim humani fallunt utique, sed tamen etiam se indicant; verum errores præsto, indicia accersita sunt. Itaque et novam prorsus tradendi viam ingressi sumus, rei ipsi convenientem: non disputando, aut exempla rara et sparsa adducendo; cum uterque fidei faciendæ modus fortasse adversus nobis futurus fuisset, quorum decreta nec in cura[1] notionum, nec in angustiis experientiæ abscissæ et truncatæ, fundata sint: sed experientiam coacervatam et continuam adhibuimus, atque homines ad fontes rerum adduximus, ac universum intellectus processum et derivationes sub oculos posuimus. Quare quicunque eo animo sunt, ut aut argumentis nitantur, aut paucis exemplis cedant, aut authoritatibus impediantur, aut opus hoc nostrum evol-

[1] So in the original: a misprint, I suspect, for *aura*.

vere et introspicere propter aut animi aut temporis angustias non possint; cum illis nos profecto de hac re nec serio colloqui possumus. Satis fuerit si illud Philocratis de Demosthene dictum huc transferimus: *Atque nolite mirari, Athenienses, si mihi cum Demosthene non conveniat. Ille enim aquam, ego vinum bibo.* Illi enim certe liquorem bibunt crudum, ex intellectu vel sponte manantem vel industria quadam haustum. Nos autem liquorem paramus et propinamus ex infinitis uvis confectum, iisque maturis et tempestivis, et per racemos decerptis et collectis, et subinde torculari pressis, et rursus in vase se separantibus et clarificatis. Ne enim hoc Deus siverit, ut phantasiæ nostræ somnium pro exemplari mundi edamus; sed potius benigne faveat, ut apocalypsin et visionem vestigiorum et viarum Creatoris in Natura et Creaturis conscribamus.

FILUM LABYRINTHI,

SIVE

INQUISITIO LEGITIMA DE MOTU.

MACHINA Intellectus inferior: seu sequela chartarum ad apparentiam primam.

Racemi sive Charta Historiæ ordinatæ ad Articulum Primum:

De Formis et Differentiis Motus.

Motus Applicationis Exterioris, sive motus adherentiæ.

Motus Applicationis Interioris, sive motus mixturæ.

Motus Applicationis ad Fibras, sive motus identitatis.

Motus Assimilationis, seu motus generationis Jovis.

Motus Signaturæ, sive motus generationis Saturni.

Motus Excitationis, sive motus generationis fictæ.

Racemi sive Charta Historiæ ordinatæ ad Articulum Secundum:

De Subjectis sive Continentibus Motum.

Racemi sive Charta Historiæ ordinatæ ad Articulum Tertium:

De Vehiculis sive Deferentibus Motum.

Racemi sive Charta Historiæ ordinatæ ad Articulum Quartum:

De Operationibus et Consequentiis Motus.

Racemi sive Charta Historiæ ordinatæ ad Articulum Quintum:

De Curriculis sive Clepsydris Motus.

Racemi sive Charta Historiæ ordinatæ ad Articulum Sextum:

De Orbe Virtutis Motus.

Racemi sive Charta Historiæ ordinatæ ad Articulum Septimum:

De Hierarchia Motus.

Racemi sive Charta Historiæ ordinatæ ad Articulum Octavum:

De Societatibus Motus.

Racemi sive Charta Historiæ ordinatæ ad Articulum Nonum:

De Affinitatibus Motus.

Racemi sive Charta Historiæ ordinatæ ad Articulum Decimum:

De viribus Unionis in Motu.

Racemi sive Charta Historiæ ordinatæ ad Articulum Undecimum:

De viribus Consuetudinis et Novitatis in Motu.

Racemi sive Charta Historiæ ordinatæ ad Articulum Duodecimum:

De aliis omnibus Motus.[1]

Syllabæ, sive Charta Anatomiæ.

Vena relicta, seu Charta Divisionis Secundæ.

Axioma Exterius, sive Charta Observationis.

Columnæ, sive Charta Impossibilis Apparentis, sive Humana Optativa.

[1] So in the original.

Fœnus, sive Charta Usus Intervenientis sive Humana Activa.

Anticipatio, sive Charta Interpretationis Sylvestris.

Pons, sive Charta ad Chartas Novellas.

Machina Intellectus Superior; sive sequela Chartarum ad Apparentiam Secundam.

Chartæ Novellæ.

Atque exemplum Inquisitionis de Natura (ut videre est) absolvimus, idque in subjecto omnium maxime capaci et diffuso; eaque forma, quam judicamus cum veritate et intellectu summum consensum habere. Neque tamen more apud homines recepto formulæ alicui necessitatam imponimus, tanquam unica esset, et instar artis ipsius. Sed certe omnibus pertentatis, ex longo usu et nonnullo, ut putamus, judicio, hanc ipsam formam sive rationem disponendi materiam rerum ad opus intellectus, ut probatam et electam exhibemus. Nihil autem officit, quominus ii qui otio magis abundant, aut a difficultatibus quas primo experientem sequi necesse est liberi jam erunt, aut majoris etiam et altioris sunt ingenii, rem in potius perducant. Nam et ipsi statuimus, artem inveniendi adolescere cum inventis; neque ad aliquid immotum et inviolabile inveniendi artificium hominum industriam et felicitatem astringendam. Artis enim perfectionem artis usum remorari, nihil est necesse. Quod autem viam novam scientiam docendi et tradendi ingressi sumus, quod doctrinam et præcepta quasi prætereuntes et aliud agentes distulimus, atque in exemplo præcipue elaboravimus; hoc summa ratione nos fecisse arbitramur. Neque sane homines latere volumus, quid in hac re secuti simus: nam obtinere in hominum æquitate positum est, vel potius in fortuna

communi: res enim humani generis agitur, non nostra. Primum hoc videmur adepti, quod maximum est, ut plane intelligamur. Longe enim aliud est singulis præceptis exempla subnectere, aliud universi operis figuram perfectam et quasi solidam construere et repræsentare. Etenim in mathematicis, adstante machina aut fabrica sequitur demonstratio facilis et perspicua: sed absque hac commoditate omnia videntur involuta, et quam revera sunt subtiliora. Atque etiam illud usuvenit, ut quo grandius instrumentum demonstrationis fiat, eo sit et fidelius et illustrius. Etiam putamus nos aliquem modestiæ et simplicitatis fructum percipere posse, quod nec vim nec insidias hominum judiciis fecimus aut paravimus, sed rem nudam et apertam exhibuimus. Nemo[1] enim ante nos, homines ad fontes naturæ et res ipsas adduxerunt, ut in medium consulerent; sed exempla et experientiam ad dictorum suorum fidem, non ad alieni judicii libertatem adhibuerunt: ut dupliciter nos de humano genere meritos existimemus, duas res maxime mortalibus caras et gratas, potestatem et libertatem, simul deferentes: potestatem operum, libertatem judicii. Ac veluti in judiciis civilibus ea maxime incorrupta et recta sunt ubi minimum oratorum licentiæ et turbis, aut etiam eloquentiæ, conceditur; sed omnis fere opera et tempus in testibus consumitur; eodem modo et de natura judicia exercentur optima, cum nec pugnaci nec probabili orationi aut disputationi maximæ partes tribuuntur, sed experientiæ testimoniis evidentibus et coacervatis res conficitur. Nam certe in authorum testimoniis libido et stimulus versatur: rerum autem testimonia et responsa, interdum obscura et per-

[1] So in the original. Perhaps Bacon had altered *nulli* into *nemo* and forgot to alter the plural verbs at the same time into the singular.

plexa, sed semper sincera et incorrupta sunt. Liberati etiam videmur magno malo, ex hominum fastidio et præjudicio. Solent enim viri prudentes et graves et cunctatores novitatem omnem levitatis et vanitatis nomine suspectam habere; novas autem sectas et nova placita ut larvas et umbras aspernari. Neque enim multum interesse putant, utrum homines in theoriis consentiant aut dissentiant: nisi quod vetera et recepta magis sint, ob consensum et mores, rebus gerendis accommodata. Huic malo non aliud remedium reperiebatur, nisi ut amplitudine exempli, in ipsos hominum sensus ita incurramus, ut primo aspectu quivis mediocris judicii rem solidam et sobriam esse, atque opera et utilitatem spirantem, et a novæ scholæ aut novæ sectæ ratione et consuetudine prorsus alienam, statim perspiciat et agnoscat. Speramus etiam hoc potissimum modo antiquis et aliis qui in philosophia aliquid opinati sunt, authoritatem et fidem abrogari, honorem et reverentiam conservari posse; idque non artificio quodam, sed ex vi ipsa rei. Existimamus enim subituram animos hominum cogitationem, num et illi hujusmodi diligentiam adhibuerint, aut placita et opiniones suas a tali fundamento excitaverint. Atque sane hoc dubium alicui videri potuisset, si opiniones eorum tantum ad nos pervenissent, modus autem inquisitionis et demonstrationis non apparuisset. Tum enim tale quippiam in mentem nobis venisset cogitare, illos proculdubio a meditationum suarum principio magnam vim et copiam exemplorum paravisse, eamque simili quo nos ordine, vel fortasse meliore disposuisse; sed postquam re comperta illis pronuntiare visum esset, tum demum pronuntiata et eorum explicationes et connexiones in scripta redegisse, addito sparsim uno aut altero ex-

emplo ad docendi lumen; sed primordia illa et notas ac veluti codicillos et commentarios suos in lucem edere, et supervacuum et molestum putasse; itaque fecisse ut in ædificando facere decet: nam post operis ipsius structuram, machinas et scalas et hujusmodi instrumenta a conspectu amovenda esse. Verum hæc de ipsis cogitare, nobis per ipsos integrum non est: formam enim et rationem suam inquirendi, et ipsi profitentur,[1] et scripta eorum ejusdem expressam imaginem præ se ferunt. Ea non alia fuit, quam ut ab exemplis quibusdam quibus sensus plurimum assueverat, ad conclusiones maxime generales sive principia scientiarum advolarent: ad quorum immotam veritatem, conclusiones inferiores per media derivarent: ex quibus arte constituta, tum demum si qua controversia de aliquo exemplo mota esset, quod placitis suis refragari videretur, illud per distinctiones aut regularum suarum explanationes in ordinem redigerent: aut si de rerum particularium causis mentio injiceretur, eas ad speculationes suas ingeniose accommodarent. Itaque res et totius erroris processus prorsus patet: nam et missio experientiæ præpropera fuit, et conclusiones mediæ (quæ operum vitæ sunt) aut neglectæ aut infirmo fundamento impositæ sunt; et sensui ipsi (qui non repræsentatur) ingenii quædam facta est substitutio illegitima et infelix; et si qua frequens alicubi inter eorum scripta inveniatur exemplorum et particularium mentio, id sero, et postquam jam decretum esset de placitis suis, factum esse constat. Nostra autem ratio huic maxime contraria est: quod Tabulæ affatim extra

[1] This passage and the corresponding one in the *Redargutio Philosophiarum* (p. 90.) serve to correct the reading *profitemur* in the *Nov. Org.* i. 125. — *R. L. E.*

controversiam ponunt. Quibus positis et illud sequitur, admirationem quæ quibusdam ex antiquis aut alii cuipiam tribuitur, intactam et imminutam manere. Nam in iis quæ in ingenio et meditatione posita sunt, illi mirabiles homines se præstiterunt. Nostra autem talia sunt, quæ hominum ingenia et facultates fere æquant. Nam quemadmodum ad hoc, ut linea recta[1] describatur, plurimum est in manus et visus facultate, si per constantiam manus et oculorum judicium tantum res tentatur; sin per regulam admotam, non multum; aut ut etiam simplicius verba faciamus, quemadmodum ad hoc ut longa oratio recitetur memoriter, homo memoria pollens ab homine oblivioso mirum in modum differt; sin de scripto, non item: eadem ratione et in contemplatione rerum quæ mentis viribus solum incumbit, homo homini præstat vel maxime; in ea autem quæ per Tabulas fit et earum usum rite adhibitum, non multo major in hominum intellectu eminet inæqualitas, quam in sensu inesse solet. Quin et ab ingeniorum acumine et agilitate, dum suo motu feruntur, periculum metuimus. Itaque hominum ingeniis non plumas aut alas, sed plumbum et pondera addimus. Accedit et illud, quod rem omnium difficillimam (si vis et contentio adhibeatur) per Tabulas nostras sponte secuturam non diffidimus; hanc ipsam, ut postquam homines, primo aditu fortasse difficiles et alieni, paulo post nativæ rerum subtilitati quæ oculis suis subjicitur et differentiis in experientia plane signatis et expressis assueverint, continuo fere subtilitatem verborum et disputationum, quæ hucusque hominum cogitationes occupavit et tenuit, quasi pro re ludicra et quadam incantatione et spectro habituri sint; atque de natura

[1] *recte* in the original.

decreturi, quod de fortuna dici solet, eam a fronte capillatam, ab occipitio calvam esse; omnem enim istam seram et præposteram subtilitatem, postquam tempus rerum præterierit, naturam prensare et captare, sed nunquam apprehendere et capere posse. Etiam vivum nos et plane animatum docendi genus adhibuisse arbitramur. Non enim scientiam a stirpibus avulsam, sed cum radicibus integris tradimus, ut in ingeniis melioribus velut in gleba feraciore transplantata, magnum et felix incrementum recipere possit. Nos autem, si qua in re vel male credidimus, vel obdormivimus et minus attendimus, vel defecimus et inquisitionem abrupimus, nihilominus rem ita proposuimus, ut et errores nostri, antequam massam scientiæ altius inficiant, notari et separari possint: atque etiam ut facilis et expedita sit laborum nostrorum successio et continuatio: tum autem homines vires suas noscent, cum non eadem infiniti sed omissa alii præstabunt. Etiam illud ludibrium avertisse videmur, cui frequens nostra operum mentio et inculcatio exponi posset, nisi homines inter res ipsas versari coëgissemus; hoc est, ut homines opera quæ ab aliis exigimus, et a nobis poscerent: facile enim quivis jam perspiciet, non frustra nos de operibus sermonem intulisse, cum in Tabulis ipsis paucas nec novorum operum designationes et fœnora reperiet, atque simul rationem nostram plane perspiciet, non opera ex operibus (scilicet ut empirici solent), sed ex operibus causas, ex causis rursus opera nova,[1] ut legitimi naturæ interpretes, educendi; atque propterea evitandi præmaturam et effusam a principio ad opera deflexionem, atque hujus rei legitimum et præstitutum tempus observandi et expectandi. Postremo et illud

[1] *nota* in the original.

videmur effecisse, ut homines non solum de vi et instituto hujus instaurationis nostræ, sed etiam de mole et quantitate ejus veras opiniones habeant; ne forte alicui in mentem venire possit, hoc quod molimur vastum quiddam esse et supra humanas vires; cum contra plerumque fiat, ut quod magis utile magis finitum sit: Hæc vero de natura inquisitio, vel[1] singulis non sit pervia, conjunctis vero operis etiam expedita. Quod ut pateat magis, digestum Tabularum addere visum est. Primæ Tabulæ sunt de motu; secundæ de calore et frigore; tertiæ,[2] de radiis rerum et impressionibus ad distans; quartæ, de vegetatione et vitis; quintæ, de passionibus corporis animalis; sextæ, de sensu et objectis; septimæ, de affectibus animi; octavæ, de mente et ejus facultatibus. Atque hæ Tabulæ ad naturæ separationem pertinent, et sunt ex parte formæ. Ad constructionem autem naturæ pertinent, et ex parte materiæ sunt, Tabulæ quæ sequuntur. Nonæ, de architectura mundi; decimæ, de relativis magnis, sive accidentibus essentiæ; undecimæ, de corporum consistentiis, sive inæqualitate partium; duodecimæ, de speciebus sive rerum fabricis et societatibus ordinariis: decimæ tertiæ, de relativis parvis, sive proprietatibus; ut universa inquisitio per Tredecim Tabulas absolvatur. Minores autem Tabulas (quas specilla appellamus) ex occasione et usu præsenti conficimus. Neque enim in illis ipsis ullam nisi per Tabulas et de scripto inquisitionem recipimus. Restat pars altera mole minor, vi potior; ut postquam constructionem machinæ docuimus, etiam de usu machinæ lucem et consilia præbeamus.

[1] So in the original. I suspect that several words have been left out.
[2] *terræ* in the original.

CALOR ET FRIGUS.

PREFACE

TO THE

CALOR ET FRIGUS.

THE following fragment, which was first printed by Stephens from a MS. in Bacon's own hand, then belonging to the Earl of Oxford, and now in the British Museum (Harl. 6855.), is here reprinted from the original. By the general title *Sequela Cartarum*, and the heading[1] *Sectio ordinis*, &c., it appears to have been designed for the commencement of a methodical enquiry; but it breaks off at so early a stage that no new light can be gathered from it; and the plan upon which Bacon at this time proposed to proceed in these investigations he afterwards materially altered. For the final shape which his speculations concerning Heat and Cold took, see the second book of the *Novum Organum*.

J. S.

[1] This heading is carefully and fairly written out in Bacon's Roman hand at the top of every page; not in a single line, as it is here printed, but thus: —

Calor et Frigus
Sectio ordinis
Carta Suggestio

SEQUELA CARTARUM;

SIVE

INQUISITIO LEGITIMA DE CALORE ET FRIGORE.

Sectio Ordinis.

Carta Suggestionis, sive Memoria Fixa.

THE sun-beams hot[1] to sense.

The moon-beams not hot,[2] but rather conceived to have a quality of cold, for that the greatest colds are noted to be about the full, and the greatest heats about the change.[3] *Qu.*

[1] Spelt *whott* in MS., and so throughout.

[2] Compare on this point Vol. I. p. 358. and Vol. II. p. 373. Since Mr. Ellis's notes on those passages were in type, a more decisive ex· eriment appears to have been made as to the calorific property of the moon's rays. In Mr. C. Piazzi Smyth's "Notes of Proceedings during the Astronomical Expedition to Teneriffe," date 14 Oct. 1856, I find the following paragraph:— "Happier was the enquiry into the radiation of the moon, by means of the Admiralty delicate thermomultiplier, lent by Mr. Gassiot. The position of the moon was by no means favourable, being, on the night of the full, 19 deg. south of the equator; but the air was perfectly calm, and the rare atmosphere so favourable to radiation, that a very sensible amount of heat was· found, both on this and the following night. The absolute amount was small, being about one-third of that radiated by a candle at a distance of 15 feet; but the perfect capacity of the instrument to measure smaller quantities still, and the confirmatory result of groups of several hundred observations, leave no doubt of the fact of our having been able to measure here a quantity which is so small as to be altogether inappreciable at lower altitudes."

[3] The last clause is omitted in the *Novum Organum*.

The beams of the stars have no sensible heat by themselves; but are conceived to have an augmentative heat of the sun-beams by the instances following.

The same climate arctic and antarctic are observed to differ in cold, vt. that the antarctic is the more cold, and it is manifest the antarctic hemisphere is thinner planted of stars.

The heats observed to be greater in July than in June; at which time the sun is nearest the greatest fixed stars, vt. Cor Leonis, Cauda Leonis, Spica Virginis, Sirius, Canicula.

The conjunction of any two of the three highest planets noted to cause great heats.

Comets conceived by some to be as well causes as effects of heat, much more the stars.

The sun-beams have greater heat when they are more perpendicular than when they are more oblique: as appeareth in difference of regions, and the differences of the times of summer and winter in the same region; and chiefly in the difference of the hours of mid-day, morning, evening in the same day.

The heats more extreme in July and August than in May or June; commonly imputed to the stay and continuance of heat.

The heats more extreme under the tropics than under the line; commonly imputed to the stay and continuance of heat, because the sun there doth as it were double a cape.

The heats more about three or four of clock than at noon; commonly imputed to the stay and continuance of heat.

The sun noted to be hotter when it shineth forth between clouds, than when the sky is open and serene.

The middle region of the air hath manifest effects of cold, notwithstanding locally it be nearer the sun; commonly imputed to antiperistasis, assuming that the beams of the sun are hot either by approach or by reflexion, and that falleth in the middle term between both; or if, as some conceive, it be only by reflexion, then the cold of that region resteth chiefly upon distance. The instances shewing the cold of that region are, the snows which descend, the hails which descend, and the snows and extreme colds which are upon high mountains.

But *qu.* of such mountains as adjoin to sandy vales, and not to fruitful vales, which minister no vapours; or of mountains above the region of vapours, as is reported of Olympus, where any inscription upon the ashes of the altar remained untouched of wind or dew. And note it is also reported that men carried up sponges with vinegar to thicken their breath, the air growing too fine for respiration, which seemeth not to stand with coldness.

The clouds make a mitigation of the heat of the sun. So doth the interposition of any body, which we term shades; but yet the nights in summer are many times as hot to the feeling of men's bodies as the days are within doors, where the beams of the sun actually beat not.[1]

There is no other nature of heat known from the celestial bodies or from the air, but that which cometh

[1] The following note is inserted here in the margin: — No doubt but infinite power of the heat of the sun in cold countries, though it be not to the analogy of men, and fruits, &c.

by the sun-beams. For in the countries near the pole, we see the extreme colds even in the summer months, as in the voyage of Nova Zembla, where they could not disengage their barque from the ice, no not in July, and met with great mountains of ice some floating some fixed, at that time of the year, being the heart of summer.

The caves under the earth noted to be warmer in winter than in summer, and so the waters that spring from within the earth.

Great quantity of sulphur, and sometimes naturally burning after the manner of Ætna, in Iceland; the like written of Gronland, and divers other the cold countries.[1]

The trees in the cold countries are such as are fuller of rosin, pitch, tar, which are matters apt for fire, and the woods themselves more combustible than those in much hotter countries; as, for example, fir, pineapple, juniper: *Qu.* whether their trees of the same kind that ours are, as oak and ash, bear not, in the more cold countries, a wood more brittle and ready to take fire than the same kinds with us?

The sun-beams heat manifestly by reflexion, as in countries pent in with hills, upon walls or buildings, upon pavements, upon gravel more than earth, upon arable more than grass, upon rivers if they be not very open, &c.

The uniting or collection of the sun-beams multiplieth heat, as in burning-glasses, which are made thinner[2] in the middle than on the sides (as I take it contrary

[1] Opposite to this and to the nine preceding paragraphs, is written in the margin *Aug.*

[2] So MS. Compare Vol. I. p. 361. (where the error is avoided, though not corrected) and p. 378. note 1.

to spectacles); and the operation of them is, as I remember, first to place them between the sun and the body to be fired, and then to draw them upward towards the sun, which it is true maketh the angle of the cone sharper. But then I take it if the glass had been first placed at the same distance to which it is after drawn, it would not have had that force. And yet that had been all one to the sharpness of the angle. *Qu.*

So in that the sun's beams are hotter perpendicularly than obliquely, it may be imputed to the union of the beams, which in case of perpendicularity reflect into the very same lines with the direct; and the further from perpendicularity the more obtuse the angle, and the greater distance between the direct beam and the reflected beam.

The sun-beams raise vapours out of the earth, and when they withdraw they fall back in dews.

The sun-beams do many times scatter the mists which are in the mornings.

The sun-beams cause the divers returns of the herbs, plants, and fruits of the earth; for we see in lemon-trees and the like, that there is coming on at once fruit ripe, fruit unripe, and blossoms; which may shew that the plant worketh to put forth continually, were it not for the variations of the accesses and recesses of the sun which call forth and put back.

The excessive heat of the sun doth wither and destroy vegetables, as well as the cold doth nip and blast them.

The heat or beams of the sun doth take away the smell of flowers, specially such as are of a milder odour.

The beams of the sun do disclose some flowers, as the pimpernel, marigold, and almost all flowers else, for they close commonly morning and evening or in over-cast weather, and open in the brightness of the sun; which is but imputed to dryness and moisture which doth make the beams heavy or erect, and not to any other propriety in the sun-beams. So they report not only a closing but a bending or inclining in the *heliotropium* and *calendula*. *Qu.*

The sun-beams do ripen all fruits, and addeth to them a sweetness or fatness, and yet some sultry hot days overcast are noted to ripen more than bright days.

The sun-beams are thought to mend distilled waters, the glasses being well stopped, and to make them more virtuous and fragrant.

The sun-beams do turn wine into vinegar; but *quæ.* whether they would not sweeten verjuice?

The sun-beams doth pall any wine or beer that is set in them.

The sun-beams do take away the lustre of any silks or arras.

There is almost no mine but lieth some depth in the earth; gold is conceived to lie highest and in the hottest countries; yet Thracia and Hungary are cold, and the hills of Scotland have yielded gold, but in small grains or quantity.

If you set a root of a tree too deep in the ground that root will perish, and the stock will put forth a new root nearer the superficies of the earth.

Some trees and plants prosper best in the shade, as the bayes, strawberries, some wood-flowers.

Almost all flies love the sun-beams, so do snakes; toads and worms contrary.

The sun-beams tanneth the skin of man; and in some places turneth it to black.

The sun-beams are hardly endured by many, but cause headach, faintness, and with many they cause rheums, yet to aged men they are comfortable.

The sun causes pestilences which with us rage about autumn, but it is reported in Barbary they break up about June and rage most in the winter.

The heat of the sun and of fire and living creatures agree in some things which pertain to vivification; as the back of a chimney will set forward an apricock-tree as well as the sun; the fire will raise a dead butterfly as well as the sun and so will the heat of a living creature; the heat of the sun in sand will hatch an egg: *qu.*

The heat of the sun in the hottest countries nothing so violent as that of fire, no not scarcely so hot to the sense as that of a living creature.

The sun a fountain of light as well as heat. The other celestial bodies manifest in light, and yet *non constat* whether all borrowed as in the moon,[1] but obscure in heat.

The southern and western wind with us is the warmest, whereof the one bloweth from the sun the other from the sea, the northern and eastern the more cold; *qu.* whether in the coast of Florida or at Brasil the east wind be not the warmest and the west the coldest, and so beyond the antarctic tropic the southern wind the coldest.

The air useth to be extreme hot before thunders.

The sea and air ambient appeareth to be hotter

[1] The words *and yet . . . . moon* are interlined in the MS.

than that at land; for in the northern voyages two or three degrees farther at the open sea they find less ice than two or three degrees more south near land: but *qu.* for that may be by reason of the shores and shallows.

The snows dissolve fastest upon the sea-coasts yet the winds are counted the bitterest from the sea, and such as trees will bend from. *Qu.*

The streams or clouds of brightness which appear in the firmament, being such through which the stars may be seen, and shoot not but rest, are signs of heat.

The pillars of light which are seen upright and do commonly shoot and vary are signs of cold, but both these are signs of drought.

The air when it is moved is to the sense colder, as in winds, fannings, *ventilabra.*

The air in things fibrous, as fleeces, furs, &c. warm, and those stuffs to the feeling warm.

The water to man's body seemeth colder than the air, and so in summer in swimming it seemeth at the first going in; and yet after one hath been in a while at the coming forth again the air seemeth colder than the water.

The snow more cold to the sense than water, and the ice than snow, and they have in Italy means to keep snow and ice for the cooling of their drinks: *qu.* whether it be so in froth in respect of the liquor.

Baths of hot water feel hottest at the first going in.

The frost dew which we see in hoar frost and in the rymes upon trees or the like accounted more mortifying cold than snow, for snow cherisheth the

ground and any thing sowed in it, the other biteth and killeth.

Stone and metal exceeding cold to the feeling more than wood, yea more than jet or amber or horn which are no less smooth.

The snow is ever in the winter season, but the hail which is more of the nature of ice is ever in the summer season; whereupon it is conceived that as the hollows of the earth are warmest in the winter, so that region of the air is coldest in the summer, as if they were a fugue of the nature of either from the contrary, and a collecting itself to an union and so to a further strength.

So in the shades under trees in the summer which stand in an open field, the shade noted to be colder than in a wood.

Cold effecteth congelation in liquors so as they do consist and hold together which before did run.

Cold breaketh glasses if they be close stopped in frost, when the liquor freezeth within.

Cold in extreme maketh metals that are dry and brittle cleft and crack, *Æraque dissiliunt;* so of pots of earth and glass.

Cold maketh bones of living creatures more fragile.

Cold maketh living creatures to swell in the joints and the blood to clot and turn more blue.

Bitter frosts do make all drinks to taste more dead and flat.

Cold maketh the arters and flesh more asper and rough.

Cold causes rheums and distillations by compressing the brain, and laxes by like reason.

Cold increases appetite in the stomach and willingness to stir.

Cold maketh the fire to scald and sparkle.

Paracelsus reporteth that if a glass of wine be set upon a tarras in a bitter frost it will leave some liquor unfrozen in the centre of the glass, which excelleth *spiritus vini* drawn by fire.

Cold in Muscovy and the like countries causes those parts which are voidest of blood, as the nose, the ears, the toes, the fingers, to mortify and rot; specially if you come suddenly to fire after you have been in the air abroad, they are sure to moulder and dissolve. They use for remedy as is said washing in snow water.

If a man come out of a bitter cold suddenly to the fire he is ready to swoon or overcome.

So contrariwise at Nova Zembla when they opened their door at times to go forth he that opened the door was in danger to overcome.[1]

The quantity of fish in the cold countries, Norway, &c. very abundant.

The quantity of fowl and eggs laid in the cliffs in great abundance.

In Nova Zembla they found no beast but bears and foxes, whereof the bears gave over to be seen about September, and then the foxes began.[2]

Meat will keep from putrifying longer in frosty weather, than at other times.

In Iceland they keep fish by exposing it to the cold from putrifying without salt.

The nature of man endureth the colds in the coun-

[1] See Three Voyages, &c. Hackl. Soc. 1853, p. 130.

[2] "Before the sun began to decline we saw no foxes, and then the bears used to go from us." — *Hackl. Soc.* 1853, p. 120.

tries of Scricfinnia, Biarmia, Lappia, Iceland, Gronland; and that not by perpetual keeping in in stoves in the winter time as they do in Russia, but contrariwise their chief fairs and intercourse is written to be in the winter, because the ice evens[1] and levelleth the passages of waters, plashes, &c.

A thaw after a frost doth greatly rot and mellow the ground.

Extreme cold hurteth the eyes and causes blindness in many beasts, as is reported.

The cold maketh any solid substance, as wood, stone, metal, put to the flesh to cleave to it and to pull the flesh after it, and so put to any cloth that is moist.

Cold maketh the pilage of beasts more thick and long, as foxes of Muscovy, sables, &c.

Cold maketh the pilage of most beasts incline to grayness or whiteness, as foxes, bears, and so the plumage of fowls, and maketh also the crests of cocks and their feet white, as is reported.

Extreme colds will make nails leap out of the walls and out of locks[2] and the like.

Extreme cold maketh leather to be stiff like horn.

In frosty weather the stars appear clearest and most sparkling.

In the change from frost to open weather or from open weather to frosts, commonly great mists.

In extreme colds any thing never so little which arresteth the air maketh it to congeal; as we see in cobwebs in windows, which is one of the least and weakest thrids that is and yet drops gather about it like chains of pearl.

[1] *even* in MS.

[2] Qu. whether *lockes* or *lockers*.

So in frosts, the inside of glass windows gathereth a dew; *qu.* if not more without.

Qu. Whether the sweating of marble and stones be in frost or towards rain.

Oil in time of frost gathereth to a substance as of tallow, and it is said to sparkle some time so as it giveth a light in the dark.

The countries which lie covered with snow have a hastier maturation of all grain than in other countries, all being within three months or thereabouts.

Qu. It is said that compositions of honey, as mead[1] do ripen and are most pleasant in the great colds.

The frosts with us are casual and not tied to any months, so as they are not merely caused by the recess of the sun, but mixed with some inferior causes. In the inlands of the northern countries as in Russia the weather for the three or four months of November, December, January, February, is constant, vt. clear and perpetual frost without snows or rains.

There is nothing in our region, which, by approach of a matter hot, will not take heat by transition or excitation.

There is nothing hot here with us but is in a kind of consumption if it carry heat in itself; for all fired things are ready to consume, chafed things are ready to fire, and the heat of men's bodies needeth aliment to restore.

The transition of heat is without any imparting of substance, and yet remaineth after the body heated is withdrawn; for it is not like smells, for they leave some airs or parts; not like light, for that abideth not

[1] *meth* in MS.

when the first body is removed; not unlike to the motion of the loadstone, which is lent without adhesion of substance, for if the iron be filed where it was rubbed, yet it will draw or turn.[1]

[1] On the back of the MS. is written in Bacon's hand

Calor et Frigus
Inquisit. Legitima.

And below this again he has written first in a clear and careful hand the word *new*, and afterwards in a hurried and careless hand the word *Vetus*.

HISTORIA SONI ET AUDITUS.

PREFACE

TO THE

HISTORIA SONI ET AUDITUS.

THE following fragment was first published by Dr. Rawley in 1688, among the *Opuscula Philosophica;* and as he does not mention it among the works composed by Bacon during the last five years of his life, we may conclude that it was written before the *Sylva Sylvarum.* It may have been the commencement of the "Tables de Sono" which, as we learn from the *Commentarius Solutus*, he was preparing in the summer of 1608. If so, it must have been meant for the second in the series, — viz. Sylva, sive Carta Mater; whence its second title, "*Sylva* Soni et auditûs;" and had it been proceeded with, the several *tables* — *tabula essentiæ et præsentiæ*, *tabula absentiæ in proximo*, *tabula graduum*, &c. — would have followed in order. As far as it goes however, it must be classed among the rough collections, not yet reduced to order for the use of the understanding, and appears to aim at precisely the same object as the investigation concerning Sound which occupies the greater part of the second and third centuries of the *Sylva Sylvarum* (101—290.); being itself in fact one of the *Sylvæ* of which the great *Sylva*

was made up. By that investigation therefore it must be considered as superseded.

I do not know that any inference of importance can be drawn from a comparison of the two; but to make the comparison easier, I have referred in the footnotes to the corresponding passages of the *Sylva Sylvarum*. It will be seen that the order of the inquiry is entirely changed; so much so that I can hardly think Bacon had the Latin before him when he wrote the English; for in point of arrangement the Latin seems to be the more systematic of the two.

J. S.

HISTORIA ET INQUISITIO PRIMA

DE

SONO ET AUDITU, ET DE FORMA SONI ET LATENTE PROCESSU SONI;

SIVE SYLVA SONI ET AUDITUS.

De generatione soni, et prima percussione.
De duratione soni, et de interitu et extinctione soni.
De confusione et perturbatione soni.
De adventitiis auxiliis et impedimentis soni.
De hæsione soni, et varietate mediorum.
De penetratione soni.
De delatione soni, et directione seu fusione ejus, et de area quam occupat, simul, et separatim.
De corporum diversitate quæ reddunt sonum, et instrumentis, et de speciebus soni quæ occurrunt.
De multiplicatione, augmentatione, diminutione, et fractione sonorum.
De repercussione soni, et echo.
De conjugiis et dissidiis audibilium et visibilium, et aliarum, quas vocant, specierum spiritualium.
De celeritate generationis et extinctionis soni, et tempore in quo fiunt.
De affinitate, aut nulla affinitate, quam habet sonus cum motu aëris, in quo defertur, locali et manifesto.
De communicatione aëris percussi et elisi cum aëre et corporibus vel spiritibus ipsorum ambientibus.
De efformatione, sive articulatione soni.
De ipsissima impressione soni ad sensum.
De organo auditus, ejusque dispositione et indispositione, auxiliis et impedimentis.

De sono et auditu inter prima inquisitionem instituere visum est. Etenim expedit intellectui, et tanquam ad salubritatem ejus pertinet, ut contemplationes spiritualium (quas vocant) specierum, et operationum ad distans, misceantur cum contemplatione eorum quæ operantur tantum per communicationem substantiæ ad tactum. Deinde observationes de sonis pepererunt nobis Artem Musicæ. Illud autem solenne est et quasi perpetuum, cum experimenta et observationes coaluerint in artem, Mathematicam et Practicam intendi, Physicam deseri. Quinetiam Optica paulo melius se habet; non enim tantum pictura et pulchritudo et symmetria Opticæ proponuntur; sed contemplatio omnium visibilium. At Musicæ, tantum toni harmonici. Itaque de sonis videndum.[1]

[1] Compare *Sylva Sylvarum;* introduction to Exp. 115., &c. This paragraph is printed in the original as if it were part of the table of contents which precedes. I have introduced the mark of separation and distinction of type, it being obviously intended for the *aditus* or general introduction to the whole treatise.

HISTORIA ET INQUISITIO PRIMA

DE

SONO ET AUDITU, ET DE FORMA SONI, ET LATENTE PROCESSU SONI;

SIVE

SYLVA SONI ET AUDITUS.

De generatione soni, et prima percussione.

Collisio, sive elisio, ut vocant, aëris, quam volunt esse causam soni, nec formam nec latentem processum denotat soni, sed vocabulum ignorantiæ est et levis contemplationis.[1]

Sonus diffunditur et labitur tam levi impulsu in sua generatione; item tam longe, idque in ambitum, cum non multum pendeat ex prima directione; item tam placide absque ullo motu evidenti, probato vel per flammam, vel per plumas et festucas, vel alio quovis modo; ut durum plane videatur, soni Formam esse aliquam elisionem vel motum manifestum localem aëris, licet hoc Efficientis vices habere possit.

Quandoquidem sonus tam subito generetur, et continuo pereat, necesse videtur ut aut generatio ejus aërem de sua natura paulum dejiciat, atque interitus ejus eum restituat; ut in compressionibus aquarum, ubi

[1] Sylv. Sylv. 124.

corpus in aquam injectum complures circulos efficiat in aquis, qui proveniunt ex aqua primum compressa, deinde in suam consistentiam et dimensionem se restituente (id quod Motum Libertatis appellare consuevimus); aut contra, quod generatio soni sit impressio grata et benevola, quæ se insinuat aëri, et ad quam libenter aër se excitat; et interitus ejus sit a vi aliqua inimica, quæ aërem eo motu atque impressione diutius frui non sinit; ut in generatione ipsius corporis flammæ, in qua generatio flammæ videtur fieri alacriter, sed ab aëre et inimicis circumfusis cito destrui.[1]

Fistulatio quæ fit per os absque aliqua admota fistula, possit effici sugendo anhelitum versus interiora palati, non solum extrudendo anhelitum ad extra. Atque plane omnis sorbitio aëris ad interius dat sonum nonnullum.[2] Quod dignum admodum notatu videatur: quia sonus generatur in contrarium motus manifesti aëris, ut prima aëris impulsio videatur plane efficiens remotum, nec sit ex forma soni.

Similiter si accipiatur vitreum ovum, atque per parvum foramen aër fortiter exsugatur; deinde foramen cera obturetur, et ad tempus dimittatur; post cera a foramine auferatur; audies manifeste sibilum aëris intrantis in ovum, tractum scilicet ab aëre interiore, qui post violentam rarefactionem se restituit. Ut hoc quoque experimento generetur sonus in contrarium motus manifesti aëris.

Similiter, in ludicro illo instrumento quod vocatur lyra Judaica, tenendo latera inter dentes vibratur lingula ferrea tracta ad exterius, sed resilit interius ad aërem in palato, et inde creatur sonus.

Atque in his tribus experimentis dubium non est,

[1] S. S. 290. [2] Id. 191.

quin sonus generetur per percussionem aëris introrsum versus palatum aut ovum vitreum.

Generatur sonus per percussiones. Percussio illa fit, vel aëris ad aërem, vel corporis duri ad aërem, vel corporis duri ad corpus durum.

Exemplum percussionis aëris ad aërem maxime viget in voce humana, et in vocibus avium et aliorum animalium; deinde in instrumentis musicis quæ excitantur per inflationem: etiam in bombardis et sclopetis, ubi percussio edens sonum generatur maxime ex percussione aëris conclusi, exeuntis ex ore bombardæ aut sclopeti ad aërem externum. Nam pila indita non multum facit ad fragorem. Neque percussio corporis mollis ad corpus molle tantum repræsentatur in percussione aëris ad aërem, verum et aëris ad flammam, ut in excitatione flammæ per folles; etiam flammæ inter se, alia aliam impellens, reddunt quendam mugitum; utrum vero interveniat aër, inquiratur ulterius. Etiam omnis flamma subito concepta, si sit alicujus amplitudinis, excitat sonum summovendo (ut arbitror) aërem magis quam ex sese:[1] etiam in eruptionibus fit percussio spiritus erumpentis ad aërem ambientem; ut in crepitaculis quæ fiunt ex foliis siccis, aut sale nigro, et multis aliis immissis in ignem; et in tonitru, vel erumpente spiritu e nube, vel volutante et agitato, ut fit in tonitru magis surdo et prolongato; etiam solet (ad ludicrum) folium rosæ viridis contractum ut aërem contineat, super dorsum manus aut frontem percussum, crepare per eruptionum aëris.[2]

Exempla percussionis corporis duri ad aërem ostendunt se in instrumentis musicis sonantibus per chordas; in sibilo sagittæ volantis per aërem; in flagellatione

[1] S. S. 119. [2] Id. 123.

aëris, licet non percutiat corpus durum ; etiam in organis musicis editur sonus per aërem percutientem aquam in fistula illa quam vocant *luscinioiam*, quæ reddit sonum perpetuo tremulum, in mota aqua et rursus se recipiente : etiam in ludicris instrumentis quibus se oblectant pueri (*Gallos* vocant) ad imitationem vocum avium :[1] similiter in aliis hydraulicis.

Exempla percussionis corporis duri ad corpus durum se ostendunt vel simpliciter vel cum communicatione aëris nonnihil conclusi, præter illum aërem qui secatur sive eliditur inter corpora dura percussa ; simpliciter, ut in omni malleatione, seu pulsatione corporum durorum ; cum communicatione aëris inclusi, ut in campanis et tympanis.

Lapis injectus fortiter in aquam reddit sonum ; atque etiam guttæ pluviæ cadentes super aquam ; nec minus unda pulsans undam : in quibus percussio fit inter corpus durum et aquam.

Videtur in generatione omnis soni illud constans esse, ut aliquæ sint partes aëris, utque requiratur aër inter corpora percussa ; qui aër, in percussione corporis duri ad aërem, et corporis duri ad corpus durum, videtur manifesto secari aut elidi. Arbitror flammam ad hoc posse sufficere, vice aëris : veluti si inter flammas majores sonet campana, aut lapides percutiantur : at in percussionibus aëris ad aërem elisio aut separatio illa videtur obscurior, sed tantum videtur aër verberari et impelli, idque molliter admodum in voce leni. Attamen necesse videtur, etiam in hoc genere, ut sit aliqua elisio aëris percussi per aërem percutientem : nam etiam in aëre moto per flabellum, aër a latere ; et emisso aëre per folles, currens ille aëris qui emittitur ; dividit

[1] S. S. 172.

reliquum aërem. Verum de hoc genere elisionis aëris, quod fit ubi aëris percussio ad aërem edit sonum, ut in voce, inquiratur ulterius.

Merito dubitatur, utrum percussio illa quæ edit sonum cum aër percutitur per chordam aut alias, fiat ab initio, cum aër resiliente chorda percutitur; aut paulo post, videlicet densato per primam percussionem aëre, et deinde præstante vices tanquam corporis duri.

Ubi redditur sonus per percussionem aëris ad aërem, requiritur ut sit incarceratio aut conclusio aëris in aliquo concavo; ut in fistulando per os; in tibiis; in barbito; in voce, quæ participat ubi aër includitur in cavo oris aut gutturis.[1] In percussione corporis duri ad aërem requiritur durities corporis, et citus motus; et interdum communicatio cum concavo, ut in cithara, lyra, flagellatione aëris, etc. At in percussione corporis duri ad corpus durum minus requiritur concavum, aut celer motus.

Fabulantur de pulvere pyrio albo, qui præstaret percussionem absque sono. Certum est nitrum, quod est album, ad exufflationem plurimum valere, ita tamen ut pernicitas incensionis et percussionem et sonum multum promoveat: cita autem incensio ex carbone salicis maxime causatur, qui est niger. Igitur si fiat compositio ex sulphure et nitro et ex modico camphoræ, fieri potest ut incensio sit tardior, et percussio non ita vibrans et acuta: unde multum possit diminui de sono; sed etiam cum jactura in fortitudine percussionis. De hoc inquiratur ulterius.[2]

De duratione soni, et ejus interitu et extinctione.

Duratio soni campanæ percussæ aut chordæ, qui

[1] S. S. 116. [2] S. S. 120.; where a different explanation is suggested.

videtur prolongari et sensim extingui, non provenit utique a prima percussione: sed trepidatio corporis percussi generat in aëre continenter novum sonum. Nam si prohibeatur illa trepidatio, et sistatur campana aut chorda, perit cito sonus; ut fit in espinettis, ubi si dimittitur spina, ut chordam tangat, cessat sonus.[1]

Campana pensilis in aëre longe clariorem et diuturniorem reddit sonum, licet percutiatur malleo ad extra, quam si staret fixa, et similiter malleo percutiatur. Atque de diuturniore sono reddita est jam ratio, quia trepidat diutius. Quod vero etiam primitivus sonus in pensili sit magis sonorus, in stante minus, amplius inquirendum est.

Similiter scyphus argenteus aut vitreus talitro percussus, si sibi permittatur, sonum edit clariorem et diuturniorem; quod si pes scyphi altera manu tenea-tur fixus, longe hebetiorem et brevioris moræ.

Qui redditur in barbito aut cithara sonus, manifesto non fit a percussione inter digitum aut calamum et chordam; seu inter digitum aut calamum et aërem: sed impellente digito, ac tum resiliente chorda, et resiliendo percutiente aërem. Itaque cum chorda movetur plectro, non digito aut calamo, continuari potest sonus ad placitum, propter asperitatem fili plectri resina parum obducti; unde non labitur per chordam, nec eam semel percutit, sed hæret, eamque continenter vexat; ex quo motu sonus continuatur.[2]

Potest sumi in argumentum, quod sonus sit plane genus quoddam motus localis in aëre, quod ita subito pereat. Quia in omni sectione aut impulsione aëris, aër affatim se recipiat et restituat; quod etiam aqua

[1] S. S. 207. [2] Id. 137.

facit per multos circulos, licet non tam velociter quam aër.[1]

De confusione et perturbatione soni.

In actu visus visibilia ex una parte non impediunt visibilia ex aliis partibus; quin universa quæ se offerunt undiquaque visibilia, terræ, aquæ, sylvæ, sol, ædificia, homines, simul ob oculos repræsentantur. Quod si totidem voces aut soni ex diversis partibus simul salirent, confunderetur plane auditus, nec ea distincte percipere posset.[2]

Major sonus confundit minorem, ut nec exaudiatur: at species spirituales (ut loquuntur) diversi generis a sono non confundunt sonum, sed omnia simul et semel hærent in aëre, alterum altero parum aut nihil conturbante; veluti lux, aut color, calor et frigus, odores, virtutes magneticæ; omnia hæc simul possunt hærere in aëre, nec tamen magnopere impediunt vel conturbant sonos.[3]

Causa cur plura visibilia simul ad oculum repræsentantur, altero alterum non confundente, ea omnino esse videatur; quod visibilia non cernuntur, nisi in linea recta; at soni audiuntur etiam in obliqua, aut arcuata. Itaque in area sphæræ visus quot objecta deferuntur, tot sunt coni radiorum; neque unquam alter conus in alterum coincidit: neque vertices conorum in idem punctum concurrunt, quia deferuntur in lineis rectis. At soni, qui deferuntur per lineas et rectas et arcuatas, possunt facile in unum punctum concurrere, itaque confunduntur.[4] Eadem videtur causa, cur color magis vividus colorem magis obscurum non morgat; at lux major lucem debiliorem

[1] S. S. 124, 125. [2] Id. 224. [3] Id. 226, 227. [4] Id. 244.

obscurat et condit; quia lux cernitur in linea arcuata, quemadmodum et sonus. Nam licet flamma ipsa candelæ non cernitur nisi in linea recta, tamen lux undique circumfusa perfertur ad visum in lineis arcuatis, quoad corpus candelæ. Similis est ratio solis aut flammæ. Quod si opponatur, neque ipsam lucem cerni nisi in recta linea ab aëre illuminato, verum est: verum id arbitror etiam accidere sono; neque enim auditur sonus nisi in lineis rectis ab aliqua parte sphæræ soni, quo prima pulsatio pertingit. Attamen color, qui nihil aliud est quam lucis imago inæqualiter reflexa, tam debiles circumfundit species, ut aërem circumfusum parum aut nihil tingat, nisi ubi deferuntur colores in lineis rectis inter objectum et oculum.

Fiat experimentum in *aulo* (Anglice *a recorder*) duplici, in quo sit labrum, et lingua, et guttur, ad utrumque finem, ita ut applicentur ad unisonum: cava autem fistula existente duplici et continuata, sonent duo simul cantionem eandem ad utrumque finem, ac notetur utrum confundatur sonus, an amplietur, an hebetetur.[1]

Accipiantur duo cavi trunci, et conjungantur in modum crucis, ita ut in loco ubi connectuntur sint pervii; et loquantur duo ad directum et transversum truncum, et applicentur similiter aures duorum ad fines oppositos, et notetur utrum voces se invicem confundunt.[2]

De adventitiis auxiliis et impedimentis soni; de hæsione soni, et varietate mediorum.

Memini in camera Cantabrigiæ nonnihil ruinosa, ad suffulcimentum erectam fuisse columnam ferream, crassitudinis pollicis fortasse et dimidii; eam columnam,

[1] S. S. 161. [2] Id. ibid.

baculo aut alias percussam, lenem sonum exhibuisse in camera ubi stabat columna, at in camera quæ subtus erat bombum sonorum.[1]

Inquirendum, quæ corpora, et cujus soliditatis et crassitudinis, omnino arceant et excludant sonum; atque etiam quæ magis aut minus eum hebetent, licet omnino non intercipiant. Neque enim adhuc constat, quæ media interjecta magis propitia sint, quæ magis impedientia. Itaque fiat experimentum in auro, lapide, vitro, panno, aqua, oleo, et eorum crassitudine respectiva. De hoc omnino inquirendum est ulterius.[2]

Aër medium ad sonum est maxime propitium, et quasi unicum.[3] Rursus, aër humidior (arbitror) magis defert sonum quam siccior: at in nebula quid fit, non memini.[4] Nocturnus etiam magis quam diurnus: verum id silentio assignari potest.[5]

Inquiratur de medio flammæ, qualis sit operationis versus sonum; utrum videlicet flamma alicujus crassitudinis omnino arceat et intercipiat sonum, aut saltem eum magis hebetet quam aër. In ignibus Jubili hoc experiri licet.[6]

Inquirendum etiam de medio aëris vehementer moti. Licet enim ventus deferat sonum, arbitror tamen ventos vehementiores nonnihil turbare sonum, ut minus longe exaudiatur etiam secundum ventum, quam in tranquillo: de quo inquiratur ulterius.[7]

Videndum qualem reddit sonum æs, aut ferrum ignitum malleo percussum, comparatum ad eum quem reddit frigidum.[8]

[1] S. S. 151. [2] Id. 212—220. [3] Id. 217.
[4] Id. 218. [5] Id. 143. [6] Id. 219.
[7] Id. 193. [8] Id. 160.

De penetratione soni.

Lapis aëtites habet tanquam nucleum aut ovum lapidis, qui agitatus reddit sonum obtusum; item tintinnabula, sed longe clariorem si detur rima.[1]

Inquiratur ab urinatoribus, si omnino audiant subter aquam, præsertim profundiorem: atque inquiratur plane utrumque; non tantum utrum audiant sonum aliquem de supra, qui editur in aëre; sed etiam utrum audiant percussionem corporis aquæ intra aquam, ubi non est aër. Expertus hoc sum in balneo; demittebatur situla bene capax; ita autem demittebatur ore inverso in æquilibrio, ut omnino in concavo suo deferret secum aërem subter aquam ad altitudinem palmæ unius; atque ad hunc modum tenebatur situla manibus depressa, ne everteretur aut resurgeret: tum urinator inserebat caput in concavum situlæ, et loquebatur: exaudiebatur vox loquentis; etiam sermo intelligebatur articulatim, sed mirum in modum acutus, et instar sibili fere, qualis in puparum ludo vox exaudiri solet.[2]

Inquiratur illud exacte, ut reddatur omnino positivum, utrum possit generari sonus nisi sit aër inter percutiens et percussum corpus.[3] Veluti demittantur duo lapilli pensiles per filum in pelvim aquæ vel flumen, et agitentur ut percutiant se invicem in medio aquæ; vel mittatur forceps apertus in medium aquæ, et ibi claudatur: et notetur utrum edat sonum, et qualem.[4] Equidem existimo urinatores cum natant subter aquam non edere sonum; nisi fortassis aliquis esse pos-

[1] S. S. 154. [2] Id. 155.

[3] "It is certain, howsoever it cross the received opinion, that sounds may be created without air." — *S. S.* 133.

[4] "You shall hear the sound of the tongs well, and not much diminished." — *Id. ibid.*

sit per successionem motus ad superficiem aquæ, atque inde percutiente aqua aërem.

Dubium non est, quin in utribus clausis nec prorsus impletis, et agitatis, reddatur sonus, liquoris scilicet in iis contenti: nec minus redditur sonus demisso lapide in aquam, cum percutiat fundum vasis. Verum in primo experimento admiscetur aër; in secundo percussio fundi vasis per lapillum communicat cum aëre extra vas. At post percussionem primam non necesse est ut aër sit in medio per universam aream sphæræ deferentis: nam id evincitur per experimentum loquentis in situla subter aquam, ubi pars deferentis ex aqua non est aër, sed lignum situlæ et aqua; unde acuitur et minuitur sonus, et extinguitur.

Quoniam autem manifestum est, per corpora dura (velut terram figularem et vitrum) transire et penetrare sonum; idque etiam certissimum est (licet adhuc hominum observationem latuerit) inesse in omni corpore tangibili pneumaticum quiddam præter partes crassas intermixtum, videndum num hujusmodi penetratio soni non inde fiat, quod partes pneumaticæ sive aëreæ corporis tangibilis communicent cum aëre externo.[1]

Accipe catinum aquæ argenteum, alterum ligneum; accipe forcipem ferream, et percute fines ejus intra aquam in catinis illis, in distantia latitudinis pollicis fortasse aut amplius a fundo: audies sonum forcipis percussæ in catino argenteo magis multo sonorum quam in ligneo. Quod si tamen vacua forent catina, et percuteretur forceps ad eandem distantiam, parum aut nihil interesset. Ex quo liquet primum, ubi nullus est aër qui possit elidi, sed tantum aqua, edi sonum; deinde, melius communicari sonum editum per percussionem cum catino per aquam quam per aërem.[2]

[1] S. S. 136. [2] Id. 134.

Clauso[1] ore fortiter, redditur murmur (quale solet esse mutorum) per palatum; quod si nares etiam fortiter obturentur, nullum possit fieri murmur. Unde liquet, sonum illum per palatum non actuari, nisi per apertum quod intercedit inter palatum et nares.[2]

De delatione soni, et directione seu fusione ejus; et de area quam occupat, simul, et separatim.

Omnis sonus diffunditur in ambitum sphæricum a loco pulsationis, et occupat universam aream ejus sphæræ ad terminum certum, sursum, deorsum, lateraliter, undequaque.[3]

Per aream ejus sphæræ fortissimus est sonus juxta pulsationem: deinde secundum proportionem distantiæ elanguescit, et demum evanescit.

Termini ejus sphæræ extenduntur, pro acumine auditus, aliquatenus; sed est quiddam ultimum, quo in sensu maxime exquisito non pertingit sonus.

Est (arbitror) nonnihil in directione primæ impulsionis. Si quis enim staret in suggesto aperto in campis, et clamaret, longius arbitror exaudiri posset vox in prorsum a loquente, quam pone. Sic si displodatur bombarda vel sclopetus, longius arbitror exaudiri possit sonus in prorsum a bombarda aut sclopeto, quam pone.[4]

Utrum aliquid sit in ascensione soni sursum, aut in descensione soni deorsum, quod sonum promoveat in ulterius, aut cessare faciat propius, non constat. Auditur quidem plane sonus, si quis ex alta fenestra aut turri loquatur, ab iis qui stant in solo; et contra, editus ab iis qui in solo stant, a fenestra aut turri: sed ab utris facilius, aut longius, de eo inquiratur ulterius.[5]

[1] This is printed in the original as if it were part of the preceding paragraph; by a mistake no doubt of the printer or transcriber.

[2] S. S. 287. [3] Id. 201. [4] Id. 204. [5] Id. 205.

Solent in concionibus usurpari suggesta, et in concionibus imperatoriis monticelli ex cespitibus ; sed minime tamen per hæc evincitur sonum facilius defluere quam insurgere ; quoniam hujus rei possit esse causa liber in loco altiore aër, nec obstipatus aut impeditus, ut fit infra in turba : non autem motus proclivior in deorsum. Itaque in hoc experimento non acquiescat contemplatio, sed fiat experimentum ubi cætera sint paria.[1]

Vis soni excipitur tota in qualibet parte aëris, non tota in toto aëre, nisi foramen aut meatus fuerit valde exilis ; nam si stet quis in loco aliquo maxime clauso, ita ut non penetret sonus omnino, idque in quacunque parte sphæræ soni, et fiat foramen parvum, vox articulata intrabit per illud foramen, et denique per tot foramina quot placuerit terebrare per universum ambitum sphæræ soni : ut manifestum sit totam illam articulationem soni deferri integram per minusculas illas partes aëris, non minus quam si aër esset undique apertus.[2]

Attendendum tamen est, utrum soni editi ex pulsationibus majoribus aëris (quales fiunt ex displosionibus bombardarum) non deveniant exiliores cum intrent illa parva foramina. Subtilitates enim sonorum forte intrare possunt non confusæ, sed universus fragor neutiquam. De hoc inquiratur ulterius.[3]

Radii corporum visibilium non feriunt sensum, nisi deferantur per medium in directum ; et interpositio corporis opaci in linea recta intercipit visum, licet alia omnino fuerint undequaque aperta. Verum sonus, si detur delatio vel meatus, vel arcuando per sursum vel inversa arcuatione per deorsum vel lateraliter vel etiam sinu-

[1] S. S. 205. [2] Id. 192. [3] Id. 216.

ando, non perit, sed pervenit. Attamen arbitror fortius deferri sonum per lineas directas inter pulsationes et aurem, et frangi nonnihil impetum per arcuationes et per sinuationes; veluti si paries sit inter loquentem et audientem, arbitror vocem non tam bene exaudiri quam si abesset paries.[1] Arbitror etiam si paulo longius collocetur vel loquens vel audiens a pariete, melius exaudiri vocem quam prope parietem, quia arcuatio tanto minus abit a linea recta.[2] Verum de hoc inquiratur ulterius.

Admota aure ad alterum terminum tubi alicujus aut cavi trunci longi, et voce submissa ad alterum orificium tubæ, exaudiri possit vox talis, quæ eadem submissione edita ad aërem apertum non pertingeret nec exaudiretur. Unde liquet, clausuram illam aëris conferre ad deferendam vocem absque confusione.[3]

Etiam communis est opinio, melius exaudiri vocem, cæteris paribus, sub tecto quam sub dio: utrum vero melius exaudiatur vox, aure collocata in aperto, voce in tecto; aut contra, aure in tecto, voce in aperto; inquiratur ulterius: licet etiam in hoc communis sit opinio, melius exaudiri quæ foras sunt in ædibus, quam quæ in ædibus foras.[4]

Commune est auditui ac visui, ac etiam quadantenus cæteris sensibus, ut intentio animi sentientis et directio expressa ad percipiendum nonnihil juvet; ut cum quis dirigit intuitum, aut (ut loquuntur) arrigit aures.[5]

[1] S. S. 202. "They move strongest in a right line; *which nevertheless is not caused by the rightness of the line, but by the shortness of the distance: linea recta brevissima.*"

[2] S. S. 214. [3] Id. 129.

[4] "And *it is certain* that the voice is better heard in a chamber from abroad than abroad from within the chamber." — *S. S.* 130.

[5] Id. 235.

Soni non perferuntur æque longe articulati et distincti, quam species et glomeratio ipsorum confusa: nam strepitus vocum exaudiri potest, ubi voces ipsæ articulatæ non audiuntur; et tinnitus musicæ confusus, cum harmonia ipsa aut cantio non exaudiatur.

In trunco cavo optime conservatur sonus. Igitur accipiatur truncus cavus, bene oblongus, et demittatur extra fenestram cameræ humilioris; loquatur quispiam exerendo caput extra fenestram ad unum terminum trunci, quam maxime potest submisse; apponat alter aurem ad alterum terminum trunci, stans infra in solo: fiat similiter hoc via versa, loquendo infra, aurem apponendo supra; atque ex hoc experimento fiat judicium, utrum vox ascendat aut descendat proclivius, aut etiam pariter.[1]

Tradunt pro certo esse loca et ædificia nonnulla ita concamerata, ut si quis stet in quadam parte cameræ et loquatur, melius exaudiri possit ad distantiam nonnullam quam prope.[2]

Omnis concentus paulo gravius et profundius sonare videtur, si removeatur nonnihil a sono edito, quam prope: ut simile quiddam videatur accidere auditui circa sonum, quale accidit visui circa species visibiles, ut nonnulla distantia ab organo sensus promoveat perceptionem sensus.

Verum fallax potest esse ista opinio, idque dupliciter. Primo, quod in actu visus requiruntur forte radii ab objecto ad pupillam, qui nulli possunt esse ubi objectum tangit pupillam; id quod inter auditum et sonum non requiritur; sed multo magis, quod ad videndum opus est luce. Objectum autem tangens pupillam intercipit lucem: at nihil hujusmodi auditui competit. Secundo

[1] S. S. 206. [2] Id. 148.

etiam, quia in visu non semper desideratur medium : quandoquidem in tollendis cataractis oculorum, stylus ille parvus argenteus, quo summoventur cataractæ, etiam super pupillam intra tuniculam oculi movens, optime cernitur.[1]

In objectis visus, si collocetur oculus in tenebris, objectum in luce, bene habet ; si objectum in tenebris, oculus in luce, non fit visio. Ita si velum tenue ponatur ob oculos, aut reticulum, objectum bene cernitur ; si super objectum, confundit visum. Atque licet fortasse neutrum horum competat sono et auditui, tamen monere possunt ut fiant experimenta, utrum auris collocata juxta truncum cavum, si sonus fiat ad distans in aperto ; aut, via versa, sonus excitatus ad cavum truncum, auris autem ponatur ad distans in aperto, promoveat magis perceptionem sensus.[2]

De corporum diversitate quæ reddunt sonum, et instrumentis, et de speciebus soni quæ occurrunt.

GENERA sonorum talem videntur subire partitionem : magnus, parvus ; acutus, gravis ; harmonicus, absonus ; summissus sive susurrans, exterior sive sonans ; simplex, compositus ; originalis, reflexus : ut sint partitiones sex.[3]

Quo fortior fuerit prima pulsatio, et delatio liberior et absque impedimento, eo major editur sonus : quo

[1] Compare 215., and S. S. 272.

[2] "And it is tried that in a long trunk of some eight or ten foot, the sound is holpen, though both the mouth and the ear be a handful or more from the ends of the trunk; and somewhat more holpen when the ear of the hearer is near than when the mouth of the speaker." — *Id.* 130.

[3] "There be these differences in general by which sounds are divided: 1. Musical, immusical. 2. Treble, base. 3. Flat, sharp. 4. Soft, loud. 5. Exterior, interior. 6. Clean, harsh or purling. 7. Articulate, inarticulate." — *Id.* 290.

debilior percussio, et magis conturbata delatio, eo minor.[1]

Acuti soni deferuntur æque longe, et fortasse longius, quam graves. De hoc melius inquiratur.

Prout majus fuerit concavum campanæ, eo graviorem edit sonum; quo minus, acutiorem.

Quo major fuerit chorda, eo reddit sonum graviorem; quo minor, acutiorem.[2]

Quo intentior fuerit chorda, eo reddit sonum acutiorem; quo laxior, graviorem: ut chorda paulo major strictius extensa, et minor laxius, eundem possint reddere sonum.[3]

In tubis similiter, et tibiis, et cornibus, et fistulis, atque etiam in ore hominis fistulantis, quo angustiora sunt et magis contracta, eo reddunt sonum acutiorem; quo latiora aut laxiora, graviorem.[4]

In tibiis, aër exiens ex foramine propiore ad spiritum, reddit sonum acutiorem; e longinquiore, graviorem:[4] ut tibia paulo major ad foramen propius, et minor ad longinquius, eundem possint reddere sonum.

In instrumentis chordarum nonnullis (ut in barbito, citharis, et similibus) invenerunt homines commoditatem ad extensionem earum præter extensionem primam, ut comprimentes eas digitis inferius aut superius, eas extendant ad alterationem soni.[5]

Si accipiatur scyphus vitreus aut argenteus et talitro percutiatur, si aqua in scypho altius ascenderit, et scyphus plenior fuerit, reddit sonum acutiorem; si humilius, et scyphus magis vacuus fuerit, graviorem.[6]

In trunco cavo, quali ad aves percutiendas utuntur, si quis ore fistulet, admoto ore ad alterum finem trunci,

[1] S. S. 164. [2] Id. 178. [3] Id. 179.
[4] Id. 178. [5] Id. 181. [6] Id. 183.

hebetatur scilicet sonus ad astantem; at si applicetur auris ad alterum finem, reddit sonum acutissimum, ut vix tolerari possit.[1]

Fiat experimentum in trunco ex parte ubi collocatur auris angusto, ex parte ubi collocatur os latiore, (et e converso,) utrum sonus reddatur acutior aut gravior; in modum speculorum quæ contrahunt aut ampliant objecta visus.

De multiplicatione, augmentatione, et diminutione, et fractione soni.

VIDENDUM quomodo possit artificialiter sonus majorari et multiplicari. Specula utrumque præstant in visu.[2] Videtur autem reflexio subita soni verti in augmentum: nam si vox et echo simul reddantur, necesse est ut non distinguatur sonus, sed majoretur. Itaque soni super flumina ampliores sunt, resonante aqua et se uniente cum sono originali.[3]

Etiam notavi, facta æde rotunda in conductibus (ut loquuntur) aquarum, et deinde caverna oblonga, ac tum æde majore (quale est videre in campis juxta *Charing-cross* prope Londinum), si fiat clamor per fenestram aut rimam ædis rotundæ, et stet quispiam juxta fenestram ædis majoris, longe terribiliorem cieri rugitum, quam fit ad aurem alicujus astantis prope ubi fit clamor.[4]

Memini in joculari ludo puparum, locutionem ita edi, ut audiatur distincte, sed longe acutior et exilior quam in aperto; ut fit in speculis quæ reddunt literas longe minutiores quam sunt in medio ordinario: ita ut videatur plane sonus per artem reddi posse et amplior et exilior.

[1] S. S. 138. [2] Id. 285. [3] Id. 144. 229. [4] Id. 140.

Tenent pueri cornu arcus tensi inter dentes, et sagitta percutiunt chordam, unde redditur sonus magis sonorus, et quasi bombus longe major, quam si arcus non teneretur a dentibus: quod imputant consensui quem habent ossa dentium cum osse auditus; quandoquidem et via versa, ex stridore in auditu etiam dentes obstupescant.[1]

Similiter tangat hasta lignum cavi lyræ, præsertim foraminis in ipso ad cavum finem, et teneatur dentibus ex altero fine, et sonet lyra; major fit sonus per prehensionem dentium, ei scilicet qui prehendit.

Certissimum est (licet non animadversum) quod vis illa, quæ post primam percussionem defert pilas aut sagittas aut spicula, et similia, consistat in partibus minutis corporis emissi, et non in aëre perpetuo deferente, instar scaphæ in aqua. Hoc posito, videndum utrum non possit diminui sonus in bombarda, aut sclopeto, absque magna debilitatione percussionis, hoc modo. Fiat sclopetum cum tubo bene forti, ut non facile frangatur; fiant in tubo quatuor aut quinque foramina, non instar rimarum, sed rotunda circa medium tubi. Percussio suas jam accepit vires, nisi quatenus ratione longitudinis tubi augeantur: at percussio aëris ad exitum sclopeti, quod generat sonum, multum extenuabitur ab emissione soni per illa foramina in medio, antequam aër inclusus perferatur ad os sclopeti. Itaque probabile est, sonum illum et bombum multis partibus diminutum fore.[2]

[1] S. S. 149.

[2] Id. 120. "And if any man think that the sound may be extinguished or deaded by discharging the pent air before it cometh to the mouth of the piece and to the open air, that is not probable; for it will make more divided sounds; as if you should make a cross barrel hollow through the barrel of a piece, it may be it would give several sounds, both at the nose and at the sides."

De repercussione soni, et echo.

Repercussio sonorum (quam *echo* vocamus) in argumentum sumi potest, non esse sonum motum localem aëris. Nam si esset, debuerat repercussio fieri in modo consimili ad originale; ut fit in omnibus repercussionibus corporeis. At in sono cum tam accurata requiratur generatio, ut in voce, quæ tot habet instrumenta, et in instrumentis musicis quæ subtiliter fabricata sunt, ea quæ reddunt sonum repercussum nihil horum habent, sed rudia plane sunt, et illud fere habent ut sonus non transeat, vix aliud quippiam.[1]

De conjugiis et dissidiis audibilium et visibilium, et aliarum, quas vocant, specierum spiritualium.

Conveniunt in his.[2]

Ambo diffunduntur in circuitum sphæricum, et occupant universam aream ejus sphæræ, et feruntur ad spatia bene longinqua, et elanguescunt paulatim secundum distantiam objecti, deinde evanescunt. Ambo deferunt figuras et differentias suas per portiones minutas sphæræ suæ, integras et inconfusas; ut percipiantur per foramina parva non secus quam in aperto.

Ambo sunt generationis et delationis valde subitæ ac celeris; ac e contra extinguuntur et pereunt subito et celeriter.

Ambo suscipiunt et deferunt minutas differentias et accuratas, ut colorum, figurarum, motuum, distantiarum in visibilibus; vocum articulatarum, tonorum harmonicorum, et pernicis alterationis sive trepidationis ipsorum in audibilibus.

[1] S. S. 287. [2] Id. 255—266.

Ambo in virtute et viribus suis non videntur vel emittere aliquam corporalem substantiam in media sua, aut ambitum sphæræ suæ; nec etiam edere aut ciere manifestum motum localem in mediis suis, sed deferre quasdam species spirituales, quarum ignoratur ratio et modus.

Ambo videntur non generativa alicujus alterius virtutis aut qualitatis præter virtutem propriam, et eatenus operari; alias sterilia esse.

Ambo in propria sua actione videntur tria quasi corporaliter operari. Primum, quod fortius objectum mergat et confundat debilius, ut lux solis lucem candelæ, displosio bombardæ vocem. Secundum, quod excellentius objectum destruat sensum debiliorem, ut lumen solis oculum, sonus violentus in proximo ad aurem auditum. Tertium, quod ambo repercutiuntur, ut in speculis et echo.

Neque objectum unius confundit aut impedit objectum alterius; velut lux aut color sonum, aut e contra.

Ambo afficiunt sensum in animalibus, idque objectis secundum magis aut minus gratis aut odiosis: attamen afficiunt etiam modo suo inanimata proportionata et organis sensuum (ut videtur) conformia; ut colores speculum, quod crystallinum est instar oculi; soni locos reverberationis, qui videntur etiam similes ossi et cavernæ auris.

Ambo operantur varie prout habent media sua bene aut perperam disposita.

Ad ambo medium magis conducibile et propitium est aër. In ambobus, in objectis accuratioribus, nonnihil affert intentio sensus, et quasi erectio ejus ad percipiendum.

Differunt in his.[1]

VIDENTUR species visibilium esse tanquam emissiones radiorum a corpore visibili, instar fere odorum. At species audibilium videntur magis participare ex motu locali, instar percussionum quæ fiunt in aëre: ut cum dupliciter plerumque operentur corpora, per communicationem naturæ suæ, aut per impressionem aut signationem motus, videatur diffusio illa in visibilibus magis ex primo modo participare, in audibilibus ex secundo.

Videtur delatio sonorum magis manifesto deferri per aërem, quam visibilium. Neque enim, arbitror, ventus vehemens tantum impedire potest aliquod visibile a longe, quam sonum; flante, intelligo, vento in contrarium.

Insignis est illa differentia, unde etiam plurimæ minores differentiæ derivantur, quod visibilia (excepta luce originali) non feruntur nisi per lineas rectas, cum soni deferantur per lineas arcuatas.

Hinc fit quod visibilia alia alia non confundant simul repræsentata; soni contra. Hinc fit quod soliditas substantiæ non videatur impedire visum magnopere, modo posituræ partium corporis sint ordine simplici et per rectos meatus, ut in vitro, aqua, crystallo, adamante: at parum panni serici aut linei rumpit visum, cum sint corpora valde tenuia et porosa; at hujusmodi panni parum aut nihil impediunt auditum, ubi solida illa quam plurimum. Hinc fit quod ad reverberationem visibilium sufficiat parvum speculum, aut simile corpus perspicuum, modo ponatur in linea recta, ubi visibilia meant; at ad faciendam reverberationem echus oportet sonum etiam a lateribus includere, quia fertur undequaque.

[1] S. S. 268—276.

Longius fertur objectum visibile, pro rata proportione, quam sonus.[1]

Visibilia nimis prope admota ad oculum non tam bene cernuntur quam per distantiam nonnullam, ut radii coire possint in angulo magis acuto: at in auditu, quo propius, eo melius. Verum in hoc duplex potest esse error. Prior, quod ad visum requiritur lux: ea autem, objecto ad oculum propius admoto, arcetur. Nam audivi ex fide digno, qui curabatur ex cataractis oculorum, cum stylus ille minutus argenteus duceretur super ipsam pupillam oculi sui, eamque tangeret, absque ullo medio (existente stylo illo, seu acu argentea, longe angustiore quam pupilla erat oculi) eum clarissime vidisse stylum illum. Secundus, quod sit plane interposita caverna auris ante instrumentum auditus, ut sonus exterior tangere os et membranam auditus plane nequeat.

Celerius deferuntur species visus quam soni, ut percipitur in flamma, et sonitu sclopetorum; etiam in fulgure, et tonitru, ubi tonitru auditur post pausam.

Etiam existimo diutius hærere species soni, quam visibilia. Licet enim et illæ non subito intereant, ut manifestum est in circulo vertente, et chordis talitro percussis, et crepusculo, et similibus; tamen diutius arbitror durant soni, quia deferuntur a ventis.

Radii lucis glomerati etiam inducunt calorem, quæ est actio diversa a visibili. Similiter, si verum sit clamores aves volantes dejecisse, etiam ea est actio protinus diversa ab audibili.[2]

Non videtur in visibili esse objectum tam odiosum ad

[1] In the original this sentence stands as part of the preceding paragraph; which is clearly wrong.

[2] S. S. 267.

sensum, quam in audibili; sed magis ex æquo. Nam fœda visui magis displicent ob excitationem phantasiæ de rebus fœdis, quam propter se; at in audibilibus, sonitus serræ dum acuitur, et similia, inducunt horrorem; et tonus discordans in musica statim rejicitur et respuitur.

Non constat esse refractionem in sonis, ut in radiis. Attamen proculdubio resiliunt soni; sed illud reflexioni assignandum. Neque enim (arbitror) si sonus pertranseat diversa media, ut aërem, pannum, lignum, alium esse locum soni ubi defertur, alium ubi audiatur; id quod proprium refractionis est;[1] sed videtur pendere ex operatione in lineis rectis refractio; id quod non competit sono.

Contractio vero soni et dilatatio ejus, secundum dispositionem medii fit proculdubio, ut in puparum vocibus et locutione sub aqua: contrahitur sonus in caverna illa, in campis dilatatur; quemadmodum per specula dilatantur et contrahuntur visibilia.

Medium trepidans (ut fumus in visibilibus) facit visibilia objecta etiam trepidare: at in sonis nihil adhuc tale invenitur, nisi forte accessio et recessio per ventos.[2] Nam trepidatio in fistula lusciniolæ, est trepidatio percussionis, non medii.

Post multam lucem mutando ad tenebras, vel post tenebras ad lucem, confunditur parum visus: utrum vero hoc fiat a magnis fragoribus, aut alto silentio, inquirendum.

[1] S. S. 254. The last sentence of this paragraph is omitted in the *Sylva Sylvarum*, and in place of it we read, "But majoration, which is also the work of refraction, appeareth plainly in sounds, as hath been handled at full, but it is not by diversity of mediums."

[2] Id. 264.

De celeritate generationis et extinctionis soni, et tempore in quo fiunt.

Omnis sonus cito admodum generatur, et cito interit. Celeritas autem motus ipsius, et differentiarum ejus, non tam mirabilis res videtur. Etenim digitorum motus in cithara, aut anhelitus in fistula aut tibia, celeres admodum inveniuntur; etiam lingua ipsa (non curiosum prorsus organum) tot peragit motus quot literas. Quod vero soni non solum tam perniciter generentur, sed et tantum spatium sua vi et impressione quasi momentanea occupent subito, id summam admirationem habet. Nam, exempli gratia, homo in medio campo vociferans exauditur ad quartam partem milliaris in ambitu, idque verbis articulatis, iisque in singulis minutis portionibus aëris hærentibus, idque in spatio temporis longe minore fortasse minuto.[1]

De spatio temporis in quo defertur sonus, inquirendum. Id hoc modo inveniri potest. Stet homo in campanili, noctu; stet alter in plano, ad distantiam forte milliaris, aut quam procul campana exaudiri possit, habeatque paratam facem lucentem, sed co-opertam. Sonet campana in campanili; quam cito illa exaudiatur ab illo altero qui stat in plano, attollat ille facem; per hoc, ex spatio temporis inter campanam pulsam et facem visam, deprehendi possunt momenta motus soni ab eo qui stat in campanili.[2]

In tormentis igneis flamma conspicitur antequam bombus exaudiatur; cum tamen flamma sequatur exitum pilæ: ut flamma tardius exeat, citius sensum feriat. Unde recte colligitur, radios visibiles celerius diffundi et pervenire, quam species aut impressiones soni.[3]

[1] S. S. 289. [2] Id. 209. [3] Id. 210.

De affinitate aut nulla affinitate quam habet sonus cum motu aëris in quo defertur locali et manifesto.

Sonus non videtur manifesto et actualiter quatefacere et turbare aërem, ut ventus solet; sed videntur motus soni fieri per species spirituales; ita enim loquendum, donec certius quippiam inveniatur.[1]

Adeo ut existimem, sonum clamantis bene magnum, in parva ab ipso motu anhelitus distantia, vix folium aliquod populi albæ tremulum, aut festucam, aut flammam moturum.

Attamen in pulsationibus majoribus deprehenditur motus plane corporalis et actualis aëris: id vero utrum fiat a motu ipso qui generat sonum, an a concausa, aut concomitantia, non constat. Tonitrua quandoque tremere faciunt fenestras vitreas, et etiam parietes: arbitror etiam bombardas displosas, aut eruptiones cuniculorum subterraneorum idem facere.[2]

Memini etiam, ni fallor, apud Collegium Regium in Cantabrigia, esse ligneam quandam fabricam in qua campanæ pendent, eamque a campanis quando sonant quatefieri. Sed qualiscunque fuerit ille occultus motus qui est sonus, apparet illum nec absque manifesto motu in prima pulsatione gigni, et rursus per motum manifestum aëris deferri aut impediri.[3]

Verbum placide prolatum, quod ad distantiam triginta pedum forte exaudiri possit, tamen admotam flammam candelæ prope os, ad unum pedem etiam, vix trepidare faciet: ubi paulo intensior flatus oris flammam faciet tremulam multo in longiore distantia.[3]

Sonus campanarum, et similium, accedit clarior, aut recedit hebetior, prout flat ventus versus aurem aut

[1] S. S. 125. [2] Id. 126. [3] Id. 125.

adversus. Idem fit in clamore: qui contra ventum editus non tam longe auditur.[1]

Traditur, per ingentes clamores applaudentium, et voces jubili, ita aërem collisum aut rarefactum fuisse, ut deciderent aves volantes. Opinio vagatur, sonitus complurium campanarum simul, in urbibus populosis, contra et fulminum perniciem et pestilentias valere.[2]

Traduntur pro certo loca et ædificia nonnulla ita concamerata, ut si quis loquatur, atque (ut fertur) locutio ista fiat contra parietem in una parte cameræ, melius exaudiantur verba post distantiam nonnullam a voce, quam prope.[3]

Notavi sedens in curru, et demisso ex una parte velo currus, aperto ex altera, mendicum, qui clamabat ex latere currus clauso, ita visum esse ac si clamaret ex latere aperto; ut vox plane repulsa circuiret, aut saltem undique sonans putaretur tamen ex ea parte audiri qua melius pertingeret.[4]

Si teneatur candela juxta foramen illud quod spiraculum est tympani, et percutiatur tympanum, concutitur et extinguitur flamma. Idem fit in sonando cornu venatoris, si apponatur candela ad exitum cornu, etc.

Etiam exquisitæ differentiæ, quas suscipit sonus, easque secum defert, demonstrant hujusmodi molles affectus non esse motus continuos locales. Nam sigilla certe in materia accommodata faciunt exquisitas impressiones; ita ut in generatione soni fortasse hoc fieri possit. Sed delatio et continuatio illa non competit, præsertim in liquidis. Exquisitas autem illas differentias intelligimus de vocibus articulatis et tonis harmonicis.[5]

[1] S. S. 125. [2] Id. 127. [3] Id. 148.
[4] Id. 203. [5] Id. 288.

Verum omnino de hac re (videlicet, quam relationem et correspondentiam habeat sonus ad motum localem aëris) inquiratur diligentius; non per viam *utrum* (quod genus quæstionis in hujusmodi rebus omnia perdidit), sed per viam *quatenus:* idque non per argumenta discursiva, sed per apposita experimenta et instantias crucis.

De communicatione aëris percussi et elisi cum aëre et corporibus vel spiritibus ipsorum ambientibus.

In percussione campanæ, sonus editus per percussionem campanæ cum malleo ab extra, et cum embolo ad intra, ejusdem est toni. Adeo ut sonus redditus per percussionem ab extra non possit generari per collisionem aëris inter malleum et extima campanæ; quandoquidem habeat rationes ad concavum campanæ ab intra. Et si foret lamina plana æris, non concavum quippiam, alius opinor foret sonus.[1]

Si fuerit rima in campana, reddit sonum raucum, non jucundum aut gratum.[2]

Videndum, quid faciat corporis quod percutitur crassitudo ad sonum, et quousque; veluti, si ejusdem concavi una campana sit crassior, altera tenuior. Expertus sum in campana ex auro, eam reddere sonum excellentem, nihilo pejorem, imo meliorem, quam campanam argenteam aut æneam. Attamen nummus aureus non tam bene tinnit quam argenteus.[3]

Dolia vacua reddunt sonum profundum et sonorum, repleta hebetem et mortuum.

At in barbito, cithara, et hujusmodi, licet prima percussio sit inter chordam et aërem exteriorem; tamen statim ille aër communicat cum aëre in ventre

[1] S. S. 124. [2] Id. 169. [3] Id. 222.

sive cavo barbiti aut citharæ. Unde in hujusmodi instrumentis fit semper perforatio aliqua, ut aër exterior communicet cum aëre concluso, absque quo sonus foret hebes et emortuus.

Fiat experimentum fistulæ illius lusciniolæ, ut impleatur oleo, non aqua; et notetur quanto sonus sit mollior, aut obtusior.

Cum redditur sonus inter anhelitum et aërem percussum in fistula aut tibia, ita tamen redditur, ut habeat communicationem nonnullam cum corpore tibiæ aut fistulæ. Alius enim fit sonus in tuba lignea, alius in ænea; alius, arbitror, si tuba per interius, aut fortasse etiam per exterius, fuerit obducta serico aut panno; alius fortasse si tuba fuerit madida, alius si sicca.[1] Etiam existimo in espinettis aut barbito, si tabula illa lignea super quam extenduntur chordæ foret ænea aut argentea, diversum nonnihil possit edere sonum.[2] Verum de his omnibus inquiratur ulterius. Etiam quatenus ad communicationem, inquirendum est, quid possit corporum diversitas et inæqualitas: veluti si penderent tres campanæ, una intra alteram, cum spatio aëris interposito, et percuteretur campana exterior malleo, qualem editura foret sonum respectu campanæ simplicis.[3]

Obducatur campana ab extra panno aut serico, et notetur, quando pulsatur campana per embolum interius, quid faciat obductio illa ad sonum.

Si foret in barbito lamina ænea aut argentea foraminata loco ligneæ, videndum quid hoc faciat ad sonum.

Usurpantur in Dania, atque etiam deferuntur ad nos, tympana ænea, non lignea, minora ligneis, atque edunt sonum (arbitror) magis sonorum.

[1] S. S. 167. 234. [2] Id. 229. [3] Id. 158.

Agitatio aëris in ventis vehementioribus non multum (arbitror) redditura sit sonum, si absint sylvæ, fluctus, ædes, aut similia; attamen receptum est, ante tempestates fieri murmura nonnulla in sylvis, licet flatus ad sensum non percipiatur, nec moveantur folia.

Desunt tria capitula, quæ perficere non vacabat.

PHÆNOMENA UNIVERSI.

PREFACE

TO THE

PHÆNOMENA UNIVERSI.

THE fragment which follows was first published by Gruter in 1653, who places it among the *Impetus Philosophici.* It appears to have been meant originally for the commencement of the third part of the *Instauratio*, with the design of which, as described in the *Distributio Operis* and the *Parasceve*, it agrees very well as far as it goes. "Tertia pars operis" (says Bacon in the *Distributio*) "complectitur *Phænomena Universi;* hoc est omnigenam experientiam, atque *historiam naturalem ejus generis quæ possit esse in ordine ad condendam philosophiam* . . . . Neque *corporum* tantum historiam exhibemus, sed diligentiæ insuper nostræ esse putavimus etiam *virtutum ipsarum* (illarum dicimus quæ tanquam *cardinales* in naturâ censeri possint, et in quibus naturæ primordia plane constituuntur, utpote naturæ primis passionibus ac desideriis; viz. *denso*, *raro;* calido, frigido; consistente, fluido; gravi, levi; aliisque haud paucis) historiam seorsim comparare." "Quod vero" (he adds in the *Parasceve*,) "in distributione operis nostri mentionem fecimus *cardinalium virtutum* in naturâ; et quod etiam harum historia, antequam ad opus interpretationis ventum fuerit, perscribenda esset; hujus

rei minime obliti sumus; *sed eam nobis ipsis reservavimus;* cum de aliorum industriâ in hâc re, priusquam homines cum naturâ paulo arctius consuescere inceperint, prolixe spondere non audeamus."

Compare these announcements with the following passage in the preface to the fragment before us. "Atque a phænomenis ætheris ordiri solennius foret. Nos autem, nil de severitate instituti nostri remittentes, ea anteferemus quæ naturam constituant et referant magis communem, cujus uterque globus est particeps. Ordiemur vero ab historiâ corporum secundum eam differentiam quæ videtur simplicissima; ea est *copia aut paucitas materiæ intra idem spatium sive eandem circumscriptionem contentæ* et exporrectæ."[1] The subject therefore which stands first in the list of these *cardinal virtues in nature* which, when he published the *Novum Organum*, he meant to reserve for his own pen and handle separately, — namely, the *Historia Densi et Rari* — is the very subject with which this fragment commences; and there need be no doubt that both the title and the præfatio properly belong to it.

There is nothing that I know of to determine the date at which it was written. But there being no allusion to it in the *Commentarius Solutus*, I suppose it was not begun in 1608. And it must certainly have been written before 1622, when the *Historia Ventorum* was published; for then the *Historia Densi et Rari* was designed for the second place in the series, not (as here) for the first. The allusion in the last paragraph but one to an instrument recently exhibited in England by certain Batavians, which uttered a musical sound when exposed to the sun, may possibly bring the uncertainty

[1] See p. 234. line 19. from the top.

within narrower limits; if the date of that exhibition can be ascertained. But in the meantime we cannot be far wrong in placing the fragment here.

Another copy of it, much enlarged and improved in the latter part, though very imperfect and apparently of earlier date in the beginning, was published by Dr. Rawley in 1658. This has already been printed in its place, with Mr. Ellis's preface and notes, to which the reader is referred.

J. S.

PHÆNOMENA UNIVERSI;

SIVE

HISTORIA NATURALIS AD CONDENDAM PHILOSOPHIAM.

PRÆFATIO.

Cum nobis homines nec opinandi nec experiendi vias tenere prorsus videantur, omni ope huic infortunio subveniendum putavimus. Neque enim major aliunde se ostendit bene merendi ratio, quam si id agatur, ut homines, et placitorum larvis et experimentorum stuporibus liberati, ipsi cum rebus magis fida et magis arcta inita societate contrahant, quasi per experientiam quandam literatam. Hoc enim modo intellectus et in tuto et in summo collocatur, atque præsto insuper erit atque ingruet rerum utilium proventus. Atque hujus rei exordia omnino a Naturali Historia ducenda sunt; nam universa philosophia Græcorum, cum sectis suis omnigenis, atque si qua alia philosophia in manibus est, nobis videtur super nimis angustam basin naturalis historiæ fundata esse, atque ex paucioribus quam par erat pronuntiasse. Arreptis enim quibusdam ab experientia et traditionibus, neque iis interdum aut diligenter examinatis,[1] reliqua in meditatione et ingenii agitatione posuere, assumpta in majorem rei fiduciam Dialectica.

[1] So in the original; a clause having apparently dropped out: such as, *aut certo compertis notionibus*, or words to that effect. Compare *Nov. Org.* i. 62.

Chymistæ autem et universum mechanicorum et empiricorum genus, si et illis contemplationes et philosophiam tentare audacia creverit, paucarum rerum accuratæ subtilitati assueti, miris modis reliquas ad eas contorquent; et placita magis deformia et monstrosa, quam rationales illi producunt. Illi enim parum ex multis, hi rursus multum ex paucis, in philosophiæ materiam sumunt; utriusque autem ratio, si verum dicendum sit, infirma est et perdita. Sed naturalis historia quæ hactenus congesta est primo intuitu copiosa videri possit, cum re vera sit egena et inutilis, neque adeo ejus generis quod quærimus. Neque enim a fabulis et deliriis purgata est, et in antiquitatem et philologiam et narrationes supervacuas excurrit; circa solida negligens et fastidiosa, curiosa et nimia in inanibus. Pessimum autem est in hac copia, quod rerum naturalium inquisitionem amplexa est, rerum autem mechanicarum magna ex parte aspernata. Atque hæ ipsæ ad naturæ sinus excutiendos longe illis præstant; natura enim sponte sua fusa et vaga disgregat intellectum, et varietate sua confundit; verum in mechanicis operationibus contrahitur judicium, et naturæ modi et processus cernuntur, non tantum effecta. Atque rursus universa mechanicorum subtilitas citra rem quam quærimus sistitur. Artifex enim operi et fini suo intentus ad alia (quæ forsan ad naturæ inquisitionem magis faciunt) nec animum erigit nec manum porrigit. Itaque magis exquisita cura opus est, et probationibus electis, atque sumptu etiam, ac summa insuper patientia. Illud enim in experimentalibus omnia perdidit, quod homines etiam a principio fructifera experimenta, non lucifera, sectati sunt; atque ad opus aliquod magnificum educendum omnino incubuere, non ad pandenda Oracula Naturæ, quod opus operum est, et omnem potesta-

tem in se complectitur. Intervenit et illud ex hominum curiositate et fastu, quod ad secreta et rara se plerunque converterunt, et in his operam et inquisitionem posuerunt, spretis experimentis atque observationibus vulgatis; quod videntur fecisse, aut admirationem et famam captantes, aut in eo lapsi et decepti, quod philosophiæ officium in accommodandis et reducendis rarioribus eventibus ad ea quæ familiariter occurrunt, non æque in ipsarum illarum vulgarium rerum causis et causarum causis altioribus eruendis, situm esse existimarunt. Universæ autem hujus de naturali historia querelæ causa ea præcipua est, quod homines non in opere tantum, sed in ipso instituto aberrarunt. Namque historia illa naturalis, quæ extat, aut ob ipsorum experimentorum utilitatem aut ob narrationum jucunditatem confecta videtur et propter se facta, non ut philosophiæ et scientiis initia et veluti mammam præbeat. Itaque huic rei pro facultate nostra deesse nolumus. Nobis enim quantum philosophiis abstractis sit tribuendum, jampridem constitutum est. Etiam vias Inductionis veræ et bonæ, in qua sunt omnia, tenere nos arbitramur, et intellectus humani versus scientias facultatem incompetentem et prorsus imparem, veluti per machinas aut filum aliquod labyrinthi, posse juvare. Neque nescii sumus, nos, si instaurationem illam scientiarum quam in animo habemus intra inventa ulla majora cohibere voluissemus, ampliorem fortasse honoris fructum percipere potuisse. Verum cum nobis Deus animum indiderit qui se rebus submittere sciat, quique ex meriti conscientia et successus fiducia speciosa libens prætereat; eam etiam partem operis nobis desumpsimus, quam existimamus alium quemquam aut in universum fugere, aut non pro instituto nostro tractare voluisse. Circa

hoc autem duo sunt, de quibus homines et alias, et nunc præcipue cum ad rem ipsam accingimur, monitos volumus. Primo, ut mittant illam cogitationem, quæ facile hominum mentes occupat et obsidet, licet sit falsissima et perniciosissima, eam videlicet, quod rerum particularium inquisitio infinitum quiddam sit et sine exitu: cum illud verius sit, opinionum et disputationum modum nullum esse, sed phantasias illas ad perpetuos errores et infinitas agitationes damnari; particularia autem et informationes sensus (demptis individuis et rerum gradibus, quod inquisitioni veritatis satis est) comprehensionem pro certo, nec eam sane vastam aut desperatam, patiuntur. Secundo, ut homines subinde meminerint quid agatur, atque cum inciderint in complures res vulgatissimas, exiles, ac specie tenus leves, etiam turpes, et quibus (ut ait ille) honos præfandus sit, non arbitrentur nos nugari, aut mentem humanam inferius quam pro dignitate sua deprimere. Neque enim ista propter se quæsita aut descripta sunt, sed nulla prorsus alia patet intellectui humano via, neque ratio operis aliter constat; nos siquidem conamur rem omnium maxime seriam et humana mente dignissimam, ut lumen naturæ purum et minime phantasticum (cujus nomen hactenus quandoque jactatur, res hominibus penitus ignota est), per facem a divino numine præbitam et admotam, hoc nostro seculo accendatur. Neque enim dissimulamus nos in ea opinione esse, præposteram illam argumentorum et meditationum subtilitatem, primæ informationis sive veræ inductionis subtilitate et veritate suo tempore prætermissa aut non recte instituta, rem in integrum restituere nullo modo posse, licet omnia omnium ætatum ingenia coierint; sed naturam, ut fortunam, a fronte capillatam, ab occipitio calvam esse. Restat

itaque ut res de integro tentetur, idque majoribus præsidiis; atque exutis opinionum zelis detur aditus ad regnum philosophiæ et scientiarum (in quo opes humanæ sitæ sunt, natura enim nonnisi parendo vincitur), qualis patet ad regnum illud cœlorum, in quod nisi sub persona infantis ingredi non licet: usum autem hujus operis plebeium illum et promiscuum ex experimentis ipsis omnino non contemnimus (cum et notitiæ et inventioni hominum, pro varietate artium et ingeniorum, plurima utilia proculdubio suggerere possit); attamen minimum quiddam esse censemus, præ eo aditu ad scientiam et potentiam humanam, quem ex misericordia divina speramus. A qua etiam supplices iterum petimus, ut novis eleemosynis per manus nostras familiam humanam dotare dignetur.

Natura rerum aut libera est, ut in Speciebus, aut perturbata, ut in Monstris, aut constricta, ut in Experimentis Artium; facinora autem ejus cujuscunque generis digna memoratu et historia. Sed Historia Specierum, quæ habetur, veluti plantarum, animalium, metallorum et fossilium, tumida est et curiosa; Historia Mirabilium, vana et e rumore; Historia Experimentorum manca, tentata per partes, tractata negligenter, atque omnino in usum practicæ, non in usum philosophiæ. Nobis itaque stat decretum, historiam specierum contrahere, historiam mirabilium excutere atque expurgare; præcipuam autem operam in experimentis mechanicis et artificialibus, atque naturæ erga manum humanam obsequiis collocare. Quid enim ad nos lusus naturæ et lascivia? hoc est, pusillæ specierum ex figura differentiæ, quæ ad opera nil faciunt; in quibus nihilominus naturalis historia luxuriatur. Mirabilium au-

tem cognitio grata certe nobis, si expurgata et electa sit; sed quamobrem tandem grata? Non ob ipsam admirationis suavitatem, sed quod sæpe artem officii sui admonet, ut naturam sciens eo perducat, quo ipsa sponte sua nonnunquam præivit. Omnino primas partes ad excitandum lumen naturæ artificialibus tribuimus; non tantum quia per se utilissima, sed quia naturalium fidissimi interpretes. Num forte fulguris aut iridis naturam tam clare explicasset quisquam, antequam per tormenta bellica, aut artificiosa iridum super parietem simulacra, utriusque ratio demonstrata esset? Quod si causarum fidi interpretes, etiam effectorum et operum certi et felices indices erunt. Neque tamen consentaneum putamus ex triplici ista partitione historiam nostram distrahere, ut singula seorsim tractentur, sed genera ipsa miscebimus, naturalia artificialibus, consueta admirandis adjungentes, atque utilissimis quibusque maxime inhærentes.

Atque a phænomenis ætheris ordiri solennius foret. Nos autem nil de severitate instituti nostri remittentes, ea anteferemus quæ naturam constituunt et referunt magis communem, cujus uterque globus est particeps. Ordiemur vero ab historia corporum, secundum eam differentiam, quæ videtur simplicissima; ea est copia aut paucitas materiæ intra idem spatium, sive eandem circumscriptionem, contentæ et exporrectæ. Nam cum ex pronuntiatis de natura nil verius sit quam propositio illa gemella, *ex nihilo nihil fieri, neque quicquam in nihilum redigi*, sed quantum ipsum naturæ, sive materiæ summam universalem, perpetuo manere et constare, et neutiquam augeri aut minui. Etiam illud non minus certum, tametsi non tam perspicue notatum aut assertum sit (quicquid homines de potentia materiæ

æquabili ad formas fabulentur), ex quanto illo materiæ, sub iisdem spatiorum dimensionibus plus et minus contineri, pro corporum diversitate a quibus occupantur; quorum alia magis compacta, alia magis extensa sive fusa, evidentissime reperiuntur. Neque enim parem materiæ portionem recipit vas aut concavum aqua et aëre impletum; sed illud plus, istud minus. Itaque si quis asserat, ex pari aëris contento par aquæ contentum effici posse; idem est ac si dicat aliquid fieri posse ex nihilo. Nam quod deesse supponitur ex materia, id ex nihilo suppleri necesse foret. Rursus si quis asserat, par contentum aquæ in par contentum aëris posse verti, idem est ac si dicat aliquid posse redigi in nihilum. Nam quod superesse supponitur ex materia, id ad nihilum evanuisse similiter necesse foret. Neque nobis dubium est, quin hæc res etiam calculos pati possit, surdos fortasse in aliquibus, sed definitos et certos, et naturæ notos. Veluti si quis dicat auri corpus collatum ad corpus spiritus vini, esse coacervationem materiæ superantem ratione vicecupla simpla aut circiter, non erraverit. Itaque exhibituri jam historiam eam quam diximus de copia et paucitate materiæ, atque de materiæ coitione atque expansione, ex quibus notiones illæ Densi et Rari (si proprie accipiantur) ortum habent, hunc ordinem servabimus, ut primo corporum diversorum (ut auri, aquæ, olei, aëris, flammæ) rationes ad invicem recenseamus. Examinatis autem rationibus corporum diversorum, postea unius atque ejusdem corporis subingressus et expatiationes cum calculis sive rationibus memorabimus. Idem enim corpus etiam absque accessione aut ablatione, aut saltem minime pro rata contractionis et extensionis, ex variis impulsibus tum externis tum internis, sustinet se congerere in majorem et minorem sphæ-

ram. Interdum enim luctatur corpus, et in veterem sphæram se restituere nititur, interdum plane transmigrat, nec revertere satagit. Hic cursus primo atque differentias et rationes corporis alicujus naturalis (quoad extentum) collati cum aperturis aut clausuris suis memorabimus; videlicet cum pulveribus suis, cum calcibus suis, cum vitrificationibus suis, cum dissolutionibus suis, cum distillatis suis, cum vaporibus et auris, exhalationibus, et inflammationibus suis memorabimus; deinde actus ipsos et motus, et progressus et terminos contractionis et dilatationis proponemus, et quando se restituant corpora, quando transmigrent secundum extentum; præcipue autem efficientia et media, per quæ hujusmodi corporum contractiones et dilatationes sequuntur, notabimus; atque interim virtutes et actiones, quæ corpora ex hujusmodi compressionibus et dilatationibus induunt et nanciscuntur, obiter subtexemus. Cumque probe noverimus quam difficilis res sit, in præsenti animorum statu, jam ab ipso principio cum natura consuescere, observationes nostras ad attentionem hominum et meditationem excitandam et conciliandam adjiciemus. Quod ad demonstrationem autem attinet, sive retectionem densitatis et raritatis corporum, nil dubitamus aut cunctamur quin quoad corpora crassa et palpabilia, *motus gravitatis* (quem vocant) loco optimæ et maxime expeditæ probationis sumi possit; quo enim corpus compactius, eo gravius. Verum postquam ad gradum aëreorum et spiritualium ventum est, tum profecto a lancibus destituimur, atque alia nobis industria opus erit. Incipiemus autem ab *Auro*, quod omnium quæ habemus (neque enim tam adulta est philosophia, ut de visceribus terræ statuere debeamus), gravissimum est, atque plurimum materiæ minimo spatio complectitur, atque ad

hujus corporis sphæram reliquorum rationes applicabimus; illud monentes, historiam ponderum hic nos minime tractare, nisi quatenus ad corporum spatia sive dimensa demonstranda lucem præbeat. Cum vero non conjicere et ariolari, sed invenire et scire nobis propositum sit, hoc autem in examine et probatione experimentorum primorum magnopere positum esse judicemus, prorsus decrevimus in omni experimento subtiliore modum experimenti quo usi sumus aperte subjungere: ut postquam patefactum sit quomodo singula nobis constiterint, videant homines et quatenus fidem adhibeant, et quid ulterius faciendum sit, sive ad errores corrigendos qui adhærere possint, sive ad excitandas atque ad operandas probationes magis fidas et exquisitas. Quin et ipsi de iis quæ nobis minus explorata atque errori magis exposita et quasi finitima videbuntur, sedulo et sincere monebimus. Postremo observationes nostras (ut modo diximus) adjiciemus, ut licet omnia integra philosophiæ servemus, tamen faciem ipsam historiæ naturalis etiam in transitu versus philosophiam obvertamus. Atque porro illud curabimus, ut quæcunque ea sint sive experimenta sive observationes, quæ præter scopum inquisitionis occurrunt atque interveniunt, et ad alios titulos proprie pertinent, notemus, ne inquisitio confundatur.

TABULA COITIONIS ET EXPANSIONIS MATERIÆ PER SPATIA IN TANGIBILIBUS CUM SUPPUTATIONE RATIONUM IN CORPORIBUS DIVERSIS.

Idem spatium occupant, sive æque exporriguntur,

	Den.	Gr.		Den.	Gr.
1 Auri puri uncia, sive	20	0	4 Argenti puri . .	10	21
2 Argenti vivi . .	19	9	5 Plumbi cinerei; anglice *tinglass*	10	13
3 Plumbi . . .	12	1½			

		Den.	Gr.
6	Cupri	9	8
7	Aurichalchi	9	5
8	Chalybis	8	10
9	Æris communis	8	9
10	Ferri	8	6
11	Stanni	7	22
12	Magnetis	5	12
13	Lapidis Lydii	3	1
14	Marmoris	2	22¾
15	Silicis	2	22½
16	Vitri	2	20½
17	Crystalli	2	18
18	Alabastri	2	12
19	Salis gemmæ	2	10
20	Luti communis	2	8½
21	Luti albi	2	5½
22	Nitri	2	5
23	Ossis bovis	2	5
24	Pulveris margaritarum	2	2
25	Sulphuris	2	2
26	Terræ communis	2	1½
27	Vitrioli albi	1	22
28	Eboris	1	21½
29	Aluminis	1	21
30	Olei vitrioli	1	21
31	Arenæ albæ	1	20
32	Cretæ	1	18½
33	Olei sulphuris	1	18
34	Salis communis	1	10
35	Ligni vitæ	1	10
36	Carnis ovillæ	1	10
37	Aquæ fortis	1	7
38	Cornu bovis	1	6
39	Balsami Indi	1	6
40	Ligni santal. rubei	1	5

		Den.	Gr.	
41	Gagatis	1	5	
42	Cepæ recentis in corpore	1	5	
43	Caphuræ	1	4	
44	Radicis caricæ recentis	1	4	
45	Ligni ebeni	1	3½	
46	Sem. fæniculi dulcis	1	3½	
47	Succini lucidi	1	3	
48	Aceti	1	3½	
49	Agressæ ex pomis acerbis	1	3	
50	Aquæ communis	1	3	paul. min.
51	Urinæ	1	3	
52	Olei caryophyllorum	1	3	pa ul. min.
53	Vini clareti	1	2¾	
54	Sacchari albi	1	2½	
55	Ceræ flavæ	1	2	
56	Radicis Chinæ	1	2	
57	Carnis pyri brumalis crudi	1	2	
58	Aceti distillati	1	1	
59	Aquæ rosaceæ distillatæ	1	1	
60	Cineris communis	1	0½	
61	Beniovis	1	0	
62	Myrrhæ	1	0	
63	Butyri	1	0	
64	Adipis	1	0	
	Olei amygdalini dulcis	0	23½	[1]
	Olei maceris viridis expressi	0	23½	

[1] *Den.* 1. *gran.* 23. *D.* in the original; a misprint, no doubt. Compare Vol. IV. p. 33.

	Den.	Gr.		Den.	Gr.
Herbæ sampsuchi . .	0	22	Ligni quercus . .	0	19½
Petrolei . . .	0	23	Fuliginis communis et camino pressi.	0	17
Florum rosæ . .	0	22			
Spiritus vini . .	0	22	Ligni abietis . .	0	15

Modus experimenti circa tabulam suprascriptam.

INTELLIGANTUR pondera quibus usi sumus ejus generis et computationis, quibus aurifabri utuntur, ut libra capiat uncias 12, uncia viginti denarios, denarius grana 24. Delegimus autem corpus auri, ad cujus exporrectionis mensuram reliquorum corporum rationes applicaremus, non tantum quia gravissimum, sed quia maxime unum et sui simile. Reliqua enim corpora quæ quiddam continent volatilis, etiam ignem passa varietatem retinent ponderis et spatii; sed aurum depuratum eam plane exuisse videtur, atque ubique simile esse. Experimentum vero hujusmodi erat. Unciam auri puri in figuram aleæ sive cubi efformavimus; dein vasculum quadratum paravimus, quod corpus illud auri caperet, atque ei exacte conveniret, nisi quod esset nonnihil altius; ita tamen ut locus intra vasculum quo cubus ille auri adscenderat linea conspicua signaretur. Id fecimus liquorum gratia, ut cum liquor aliquis intra idem vasculum immittendus esset, ne diffluereet; atque hoc modo justa mensura commodius servari posset. Simul autem aliud vasculum fieri fecimus, quod cum altero illo, pondere et contento prorsus par esset; ut in pari vasculo corporis contenti tantum ratio appareret. Tum cubos ejusdem magnitudinis sive dimensi fieri fecimus, in omnibus materiis in Tabula specificatis quæ sectionem pati possent; liquoribus vero ex tempore usi sumus, implendo scilicet vasculum quousque liquor ad locum illum signatum adscenderet; pulveres eodem modo; sed intelligantur

pulveres maxime et fortiter compressi. Hoc enim potissimum ad æquationem pertinet, nec casum recipit. Itaque non alia fuit probatio, quam ut unum ex vasculis vacuum cum uncia in una lance, alterum ex vasculis cum corpore in altera parte poneretur, et ratio ponderis exciperetur; quod quanto esset diminutum, tanto dimensum ejusdem corporis intelligitur auctum. Exempli gratia, cum auri cubus det unciam unam, adipis vero denarium unum; liquet exporrectionem corporis auri, collatam ad exporrectionem corporis adipis, habere rationem vicecuplam. Mensuræ autem ejus quæ unciam auri capiebat, modum etiam excipere et notare visum est; ea erat pintæ vinariæ, qualis apud nos Anglos in usu est, pars 269 paulo minus. Probatio vero talis erat. Pondus aquæ quod intra vasculum sub illa linea continebatur notavimus, ac tum pondus aquæ intra pintam contentum similiter notavimus, et ex rationibus ponderum rationes mensurarum collegimus.

Monita.

Videndum num forte contractio corporis arctior ex vi unita nanciscatur majorem rationem ponderis, quam pro quantitate materiæ; id utrum fiat necne ex historia propria ponderis constabit. Quod si fiat, fallit certe supputatio; et quo corpora sunt extensiora, eo plus habent materiæ quam pro calculo ponderis et mensuræ, quæ ex eo pendet.

2. Parvitas vasis quo usi sumus, et forma etiam (licet ad cubos illos recipiendos habilis et apta), ad rationes exquisitas verificandas minus propria fuit. Nam nec minutias infra grani dimidium et quadrantem facile excipere licebat, et quadrata illa superficies in parvo nec sensibili adscensu sive altitudine notabilem ponderis dif-

ferentiam trahere potuit, contra quam fit in vasis in acutum surgentibus.

3. Minime dubium est etiam complura corpora quæ in Tabula ponuntur, intra suam speciem magis et minus recipere quoad pondera et dimensa. Nam et aquæ et vina, et similia, sunt certe alia aliis graviora. Itaque quoad calculationem exquisitam casum quendam ista res recipit; neque ea individua in quæ experimentum nostrum incidit naturam speciei exacte referre, neque cum aliorum experimentis fortasse omnino in minimis consentire possunt.

4. In Tabulam superiorem conjecimus ea corpora, quæ spatium sive mensuram commode implere corpore integro et tanquam similari possent, quæque etiam pondus habeant, ex cujus rationibus de materiæ coacervatione judicium faciamus. Itaque tria genera corporum huc retrahi non poterant. Primo, ea quæ dimensioni cubicæ satisfacere non poterant, ut folia, flores, pelliculæ, membranæ. Secundo, corpora inæqualiter cava et porosa, ut spongiæ, suber, vellera. Tertio, pneumatica pondere non dotantur.

Observationes.

Coacervatio materiæ in corporibus tangibilibus, quæ ad nostram notitiam pervenerunt, intra rationes partium 21 vel circiter vertuntur. Coacervatio enim maxime compacta invenitur in auro, maxime expansa in spiritu vini (ex corporibus dicimus quæ unita sunt, nec evidenter porosa). Namque spiritus vini occupat spatium vicies et semel repetitum, quod occupat aurum, juxta rationes unciæ unius ad grana 22. Ex 21 enim illis partibus, quibus corpora alia aliis sunt magis compacta, 13 partes occupant metalla; nam stannum, quod

metallorum est levissimum, ponderis est denar. fere 8, quod decrevit infra pondus auri denariis 13. Omnigena autem illa varietas, postquam a metallis decessimus, intra 8 illas reliquas partes clauditur; ac rursus insignis illa varietas, quæ incipiendo a lapidibus inclusive ad alia illa protenditur, intra tres tantum partes aut non multo plus cohibetur. Nam lapis Lydius, qui est ex lapidibus gravissimus (excepto magnete), parum denariis 3 præponderat. Spiritus autem vini, qui est terminus levitatis in corporibus unitis, denario uno paulo levior est.

Videtur saltus magnus sive hiatus ab auro et argento vivo ad plumbum; scilicet a 20 denariis et paulo minus ad 12. Atque licet metallica magna varietate exuberent, vix tamen existimamus in hoc hiatu multa inveniri corpora media, nisi sint prorsus rudimenta argenti vivi. A plumbo autem gradatim adscenditur ad ferrum et stannum. Rursus alterum magnum hiatum sive saltum invenimus inter metalla et lapides; scilicet ab 8 denariis ad tres; tantum enim aut circiter a stanno distat ad lapidem Lydium. Solummodo inter hæc se interponit, et fere ex æquo, magnes, qui est lapis metallicus; atque existimamus inveniri et alia fossilia misturæ imperfectæ, et compositæ naturæ inter metallum et lapides. A lapidibus certe ad reliqua parvis intervallis proceditur.

In vegetabilibus autem minime dubitamus, ac etiam in partibus animalium, se ostendere quam plura corpora etiam satis æqualis texturæ, quæ spiritum vini levitate superent. Namque etiam lignum quercus, quæ videtur esse ex lignis robustis et solidis, spiritu vini est levius; et lignum abietis adhuc magis. Florum autem et foliorum plurima, et membranæ et pelliculæ, ut spolia

serpentum et alæ insectorum, et similia, proculdubio ad minores rationes ponderum (si dimensionem illam cubicam capere possent) accederent, ac multo magis artificialia, ut papyrus, linteus pannus extinctus (quali ad fomites flammarum utimur), folia rosarum quæ supersunt a distillatione, et hujusmodi.

Reperimus plerunque in partibus animalium corpora nonnulla magis compacta quam in plantis. Ossa enim et carnes magis sunt compacta quam ligna et folia. Cohibenda ac etiam corrigenda est illa cogitatio, in quam animus humanus propendet; compacta nimirum quæque et maxime solida, esse durissima et consistere maxime; fluido vero adesse naturam minus contractam. Nam coacervatio materiæ non minor est in corporibus quæ fluunt, quam in iis quæ consistunt, sed major potius. Siquidem aurum mollitie quadam vergit ad fluorem, atque cum liquescit neutiquam extenditur, sed priore spatio continetur. Et argentum vivum ex se fluit, et plumbum facile fluit, ferrum ægre, quorum alterum ex gravissimis metallis est, alterum ex levissimis. Sed illud præcipuum, quod generaliter metalla lapides (fluida videlicet corpora, fragilia) pondere longe superent.[1]

Accidit auro et argento vivo, quæ ex metallis reliquis tanto sunt graviora, res mira; nempe ut reperiantur quandoque in granis et parvis portionibus quasi a natura perfecta, et fere pura; quod nulli fere aliorum metallorum contingit, quæ necesse habent ut per ignem purgentur et coëant; cum tamen hæc duo, quorum coitio longe maxima est et verissima, id a natura quandoque absque ignis beneficio consequantur.

[1] In the original *fragilia* is not included within the parenthesis; obviously by mistake.

In inquisitione de re metallica ac de natura lapidum, attendatur parum quæ sint ea metalla, quæ solent esse cæteris depressiora, et magis in profundo sita, si quæ hujus rei norma sit et experimentum constans; in quo tamen ipso ratio habenda est regionis in qua fodinæ sunt, an ipsa fuerit terra alta, an terra humilis. Similiter de lapidibus et gemmis, crystallis, an natura lapidea penetret terram tam profunde quam metallica, an potius in superficie hæreat, quod magis existimamus.

Sulphur, quem patrem metallorum esse communis est opinio, licet a peritioribus fere repudiata, aut ad sulphurem quendam naturalem non communem translata, habet coacervationem materiæ, omni metallo, etiam lapidibus et terris robustioribus, inferiorem; scilicet denariorum 2 et granorum 2; neque id tamen obstat (si cætera convenirent) quin cum mercurio confusum, propter ejusdem eximiam gravitatem, pondera omnium metallorum pro ratione temperamenti reddere posset, præter pondus auri.

Efficiens coitionis in corporibus ad coacervationem non semper spectatur. Nam vitrum, quod coit per ignem acrem et fortem, præponderat crystallo, quod nativum est et educitur sine igne aut evidenti calore (nam quod glacies sit concreta, id populare est) atque ipsum crystallum longe ponderosius est [1] [glacie], quæ manifeste a frigore cogitur, ac tamen aquæ supernatat.

Mixtura liquorum ex rationibus ponderum solummodo non pendet aut procedit, siquidem spiritus vini cum oleo amygdalarum expresso non miscetur; sed (quod quis

[1] Some word is evidently wanting in the original. Mr. Montagu omits the parenthesis, puts a semicolon after *calore*, and inserts *ea* after *crystallum*. But I think the insertion of *glacie* gives a better sense.

fortasse non putaret) supernatat oleo, quemadmodum oleum supernatat aquæ; et tamen grano tantum et dimidio (ut in Tabula conspicitur) levior est. At idem spiritus vini aquæ licet graviori longe facilius miscetur; ut et aqua ipsa rursus facilius miscetur cum oleo vitrioli, quam cum oleo amygdalarum; et tamen oleum vitrioli aqua est granis 18 gravius; oleum amygdalarum vero tantum granis 4 levius. Neque hoc accipiendum est, quin in corporibus proportionatis ad mixturam præcipua sit ponderis ratio. Nam videmus vinum aquæ supernatare, si cohibeatur agitatio, vel primi casus sive descensus perturbatio; veluti cum in vase ubi continetur aqua vinum superinfunditur, sed mediante offa panis vel linteo, quod vim ipsam casus primi frangat. Atque idem in aqua super oleum vitrioli cum hac industria infusa usu venit. Atque quod magis est, licet vinum infundatur prius, et aqua posterius (super offam, vel per pannum ut dictum est), invenit locum suum, et permeat per vinum, et in fundo se colligit.

Continuatio Historiæ Coitionis et Expansionis Materiæ in Corpore Eodem.

Rationes pulverum majore cum utilitate inquiri si fiat collatio eorum cum corporibus ipsorum integris, quam si ponerentur per se et simpliciter, judicavimus. Hoc enim modo et de corporum diversitate et de arctissimis illis naturæ integralis nexibus et vinculis judicium fieri et rationes iniri posse animum advertimus. Intelligimus autem in rationibus pulverum, pulveres fortiter et maxime pressos. Hoc enim facit ad æquationem, nec recipit casum.

Mercurius in corpore habet in mensura illa experimentali secundum quam Tabula ordinatur, denar. 19,

grana 9; sublimatus vero in pulvere habet denar. 3, gran. 22.

Plumbum in corpore denar. 12, gran. 1 dimid. In cerussa vero in pulvere denar. 4, gran. 8 dimid.

Chalybs in corpore denar. 8, gran. 10. In pulvere præparato (quali ad medicinas utimur) denar. 2, gran. 9.

Crystallum in corpore denar. 2, gran. 18. In pulvere denar. 1. gran. 20.

Santalum rubeum in corpore denar. 1, gran. 5 dimid. In pulvere gran. 16 dimid.

Lignum quercus in corpore gran. 19 dimid. In cinere denar. 1, gran. 2.

Ut autem melius intelligantur rationes pulveris pressi et non pressi, idque pro diversitate corporum, nos pondus rosarum, quod integraliter in Tabulam recipi non poterat, in pulvere excepimus; illud in pulvere non presso dabat gran. 7, in pulvere presso gran. 22: sed idem in ligno santali rubei experti, santalum rubeum in pulvere non presso gran. 10, in pulvere presso gran. 16 dimid. dare comperimus; ut sit pulvis rosæ pulvere santali, si non premantur, multo levior, si premantur, gravior. Etiam ad supplementum Tabulæ prioris rationes pulveris excepimus in aliquo ex floribus, ex herbis, et ex seminibus (nam radicum dimensio cubica esse poterat), ad exemplum reliquorum in sua specie; ac invenimus pulverem floris rosæ, ut superius dictum est, dare gran. 22, herbæ sampsuchi gran. 23, seminis fœniculi dulcis denar. 1, gran. 3 dimid. Etiam aliorum corporum, quæ in Tabula recipi non poterant, pondera in pulveribus excepimus, ut arenæ albæ. Hæc dabat denar. 1, gran. 20. Salis communis, qui dat denar. 1, gran. 10. Sacchari, quod dat. denar. 1, gran. 2 dimid. Myrrhæ, quæ dat denar. 1. Biniorum, quæ dant denar.

1. Conspicere autem est in ipsa Tabula sulphur in corpore dare denar. 2, gran. 2: in oleo chymico denar. 1, gran. 18. Vitriolum autem in corpore denar. 1, gran. 22; in oleo denar. 1, gran. 21. Vinum in corpore dare denar. 1, gran. 2 d. qu. in distillato gran. 22. Acetum in corpore dare denar. 1, gran. 2. d. in distillato denar. 1, gran. 1.

Monita.

Quando dicimus pondus in corpore, pondus in pulvere, non intelligimus de eodem individuo, sed de corpore et pulvere ejusdem speciei, intra eandem illam mensuram tabularem contento. Nam si lignum quercus accipiatur, et idem lignum in individuo in cinerem redigatur; et plurimum de pondere deperdit, et cinis ille mensuram ligni ex magna parte non implet.

Modus versionis corporis in pulverem ad apertionem sive expansionem corporis multum facit. Alia enim est ratio pulveris qui fit per simplicem contusionem sive limaturam: alia ejus qui per distillationem, ut sublimati: alia ejus qui per aquas fortes et erosionem vertendo tanquam in rubiginem: alia ejus qui per exustionem, ut cinis, calx. Itaque ista cum ad contemplationem adhibeantur, æquiparari nullo modo debent.

Nos in singulis diutius quam pro instituti nostri ratione morari non possumus, et tamen quæ præstare non licet designare juvat; ea demum foret Tabula exacta corporum cum suis aperturis, quæ corpora singula cum pulveribus suis, cum calcibus suis, cum vitrificationibus suis, cum dissolutionibus suis, cum distillatis suis conferret.

Historiam variationis ponderum in individuis, id est ejusdem corporis integri et pulverizati, ut ejusdem

aquæ in nive aut glacie, et solutæ ejusdem,[1] ovi crudi et cocti, ejusdem pulli vivi et mortui, et similium, ad historiam propriam ponderum rejicimus.

Observationes.

In corporibus magis compactis longe arctior est compactio partium, quam ulla pulverum suorum positione aut pressura æquari potest. Et quo corpora sunt graviora et solidiora, eo major differentia redundat inter integra sua et aperturas suas, ut ratio argenti vivi crudi ad sublimatum in pulvere est quintupla et amplius; rationes chalybis et plumbi non adscendunt ad quadruplam; rationes crystalli et santali non adscendunt ad duplam.

In corporibus levioribus et porosis laxior fortasse est partium positura in integris quam in pulveribus pressis, ut in foliis siccis rosarum. Atque in hujusmodi corporibus, major intercedit differentia inter pulveres suos pressos et non pressos.

Pulverum partes ita se sustentare possunt, ut pulvis non pressus triplicem impleat mensuram ad pulverem pressum.

Corpora metallica, ut sulphur, vitriolum, in olea (quæ vocant) conversa, pondus eximie retinent, nec magnum intercedit discrimen inter olea et ipsa corpora.

Destillata proculdubio attenuantur et pondere decrescunt; sed hoc facit vinum duplo plus quam acetum.

Dignissima observatione est insignis illa apertura in

[1] So in the original. A word appears to have dropped out and the punctuation to have been disturbed. Bacon probably wrote *ut ejusdem aquæ in nive aut glacie* fixæ *et solutæ, ejusdem ovi crudi et cocti*, &c.

pulvere sublimati, ad corpus crudum, hoc nomine, quod licet tanta sit (quintupla enim est, ut diximus) idque in corpore non transeunte, ut in vaporibus argenti vivi, sed consistente, tamen tam parvo negotio rursus coit ad veterem sphæram.

Continuatio Historiæ Coitionis et Expansionis Materiæ per Spatia in Corpore eodem.

ANIMALIA natando palmis vel pedibus aquam deprimunt, ea ultra naturalem consistentiam depressa et densata resurgit, resurgens corpus grave sublevat et sustinet. Homines vero natandi peritiores corpus suum super aquam ita librare possunt, ut ad tempus absque motu brachiorum vel tibiarum se sustineant; etiam pedibus aquam calcant erecti, et alias agilitates super aquam exercent. Aves certe aquatiles palmipedes sunt, et pedum membranis aquam apte deprimunt; in profundiore autem aqua facilior est natatio.

Aves volando aërem alis verberant et condensant, aër vero (ut superius de aqua dictum est) ad consistentiam suam se restituens avem vehit. Atque aves quoque nonnunquam radunt iter suum expansis, sed immotis, alis, aut subinde alas parum concutiendo, atque iterum labendo. Neque dissimilis est ratio pennatorum et aliorum volatilium. Nam muscæ, et id genus, habent suas alarum tunicas, quibus aërem pulsant. Infirmitas autem alarum parva corporis mole sive pondere compensatur. Etiam in sublimi facilius feruntur alata, præsertim quæ alas habent amplitudine latiores, motu non ita pernices, ut ardea. Atque omnes aves, quæ aliquantæ magnitudinis sunt, magis laboriose feruntur, cum primum se a terra elevant, ubi scilicet necesse est aërem esse minus profundum.

Monitum.

Motus condensationis in aqua, aut aëre, aut similibus, per verberationem sive impulsionem manifestus est. Is hujusmodi est. Aëris vel aquæ partes, quanto ab impulsu primo seu verbere remotiores sunt, tanto infirmius impetuntur et tardius cedunt; quanto autem propius, tanto fortius et velocius; unde necessario fit, ut anterior aër celerius fugiens posteriorem tardius se expedientem consequatur, atque hoc modo coëant. Postquam autem ex ea coitione major provenerit condensatio quam natura patitur, corpora aquæ vel aëris, ut se aperiant et laxent, resiliunt et revertuntur.

Historia.

Facies aquæ atque omnis fluidi ab agitatione et perturbatione inæqualis est, idque inæqualitate mobili et successiva, quousque aqua debitam recuperet consistentiam, et pressura liberetur; ut in undis maris et fluviorum, etiam postquam venti conciderint, et in omni aqua quovis modo turbata.

Neque dubium est, quin et similis inæqualitas versetur in ventis, qui et ipsi in morem fluctuum se volvunt; neque vel cessante prima violentia se subito recipiunt in tranquillitatem; nisi quod in undulatione aëris non intervenit motus gravitatis, qui in aqua cum motu liberationis a pressura conjungitur.

Lapis super aquam literaliter jactus (ut pueri ludendo solent) resilit, atque iterum et sæpius cadit, et ab aqua repercutitur. Etiam natantes cum ex loco altiore in aquas se saltu dejiciunt, cavent sibi ne in femorum junctura vi aquæ secentur. Denique aqua manu aut corpore fortiter percussa, ferulæ aut corporis durioris

instar verberat, et dolorem incutit. Atque in scaphis et carinis, quæ vi remorum aguntur, aqua remis pone remiges trusa et pressa, non aliter scapham impellit, eamque prolabi et emicare cogit, quam cum conto ad littus posito scapha a littore summovetur. Neque enim ejus rei causa præcipua est aqua pone puppim scaphæ se colligens et scapham in contrarium protrudens, quod ipsum tamen fit a pressura se laxante.

Aër ad evitandam pressuram omnia opera corporis solidi et robusti edit et imitatur, ut fit in ventis, qui naves agunt, arbores, domos evertunt,[1] prosternunt, et similia. Etiam non alia vi quam ipsorum anhelitu, cum balista cava et longa quæ aëris compressionem juvet, jaculamur ictu nonnullo.

Pueri ad imitationem tormentorum alnum excavant, et partes radicis iridis aut papyri globulati ad utrumque siphonis finem infarciunt, deinde cum embolo ligneo globulum protrudendo emittunt, globulus autem ulterior emittitur cum sono et impetu, antequam ab embolo ullo modo tangatur, a vi aëris inclusi et compressi.

Aër impulsu densatus frigidior, et magis ad naturam aquæ appropinquans videtur, ut cum flabris ventum facimus, aut concitato gradu aërem impellendo rursus reflantem sentimus, aut ore contracto frigidum spiramus, aut ex follibus ventum emittimus. Quinetiam sub dio ventis flantibus, major fit refrigeratio, quam aëre quieto et placido.

In sonorum generatione aër densatus corporis solidi naturam imitatur; nam quemadmodum inter duo corpora solida percussione sonus generatur, ita etiam inter corpus solidum et aërem densatum fit sonus, et rursus

[1] So in the original. It should probably be *arbores evertunt, domos prosternunt.*

inter aërem densatum et alium aërem ex adverso densatum. Nam in instrumentis musicis cum chordis manifestum est, sonum non emitti ex tactu seu percussione inter digitum vel plectrum et chordam, sed inter chordam et aërem. Chorda enim cum resilit, idque motu celerrimo propter intentionem, aërem primo densat, dein percutit. Instrumenta autem ex spiritu, propter infirmiorem motum spiritus quam chordæ, necesse habent ut forma sint cava et conclusa, ad juvandam compressionem aëris ; quod etiam in instrumentis cum chordis juvamenti loco adhibetur.

Aqua arctata et constipata magno impetu se laxat et diffundit in latera, ut latitudinem debitam consequatur, ut sub arcubus pontium. Simili modo et ventus per angustias densatus invalescit et furit. Adversi autem gurgites aquarum turbines aquarum generant vorticosos, ut quoniam debita relaxatio fieri non potest, singulæ partes pressuram ex æquo tolerent.

Aqua ex angustiis subito violenter emissa corporis continui, veluti fili aut virgæ aut trunci, imaginem refert, et fit primum directa, post arcuata, deinde se scindit, et in guttas hinc illinc in orbem se dispertit, ut in fistulis sive syringis et impluviis.

Est genus turbinis in paludibus non infrequens, præsertim post fœnum demessum, aut saltem ex ea occasione se conspiciendum præbens. Iste typhon quandoque cumulum fœni in aërem sublevat, et ad tempus fere unitum et non multum dispersum evehit, donec postquam ad altitudinem magnam evectum sit, fœnum conopei instar distendat et spargat.

Catinum ligneum vacuum versum, et ad superficiem aquæ æqualiter appositum, et postea sub aquam demersum, secum portat usque ad fundum vasis aërem univer-

sum qui antea in catino continebatur: quod si cum simili æquilibrio rursus ex aqua educatur, invenias aërem in non multo minus spatium quam antea implebat se recepisse, quod ex coloratione labri catini ad locum quo aqua adscenderat, et a quo introrsum aër se receperat, manifestum erit.

In cubiculo ubi ventus flarit aperta fenestra, si non detur exitus ex aliqua alia parte, ventus, nisi vehemens fuerit, non admodum sentitur, cum a corpore aëris quod cubiculum impleverat et sub primo flatu nonnihil densatum fuerat, et amplius densari recusat, non recipiatur; dato autem exitu tum demum manifesto sentitur.

Ad commodiorem moram operariorum qui sub aqua opus aliquod moliuntur et peragunt, excogitatum fuit, ut dolium quoddam instar alvei pararetur, ex metallo sive aliqua materia quæ fundum peteret, id tripode sustineretur pedibus ad labrum dolii affixis, qui pedes essent altitudinis minoris quam staturæ hominis. Dolium istud in profundum demittebatur, cum universo quem continebat aëre, eo modo quo de catino dictum est, et in pedes suos plantabatur et stabat juxta locum ubi opus faciendum esset. Urinatores autem, qui iidem erant operarii, cum sibi respiratione opus esset, caput in cavum dolii inserebant, et recepto aëre rursus ad opus se conferebant. Nos quoque in balneo famulum fecimus caput suum in pelvim subter aquam cum aëre depressam inserere, qui ad dimidium quartæ partis horæ sub eodem mansit, donec aërem, ex anhelitu suo tepefactum, sensum quendam suffocationis induxisse sentiret.

Aër exiguam aliquam contractionem non ægre admittit. Id in vesica experiri res fallax est. Nam cum inflatur vesica, densatur ipso flatu aër, ut aër intra vesicam densior sit quam aër communis, ideoque non mirum

est si ad novam condensationem sit ineptior. Sed in experimento illo vulgari de catino ligneo subter aquam depresso, cerni datur aquam subintrantem ex extremo vasis nonnihil occupasse, atque aërem tantidem spatii detrimentum fecisse.

Sed ut de proportione magis liquido constet; globulum, vel aliud corpus solidum et ima petentem, in fundo vasis posuimus, super quod catinus imponendus esset; tum catinum (metallicum scilicet, non ligneum, quod in imo vasis stare ex sese posset) superimposuimus. Quod si corpus illud exiguæ sit magnitudinis, cum in concavum catini recipitur aërem contrudit, non extrudit. Quod si grandioris fuerit magnitudinis quam ut aër libenter cedat, tum aër, majoris pressuræ impatiens, catinum ex aliqua parte elevat, et in bullis adscendit.

Atque fieri fecimus globum cavum ex plumbo lateribus non admodum exilibus, ut vim mallei vel torcularis sustinere melius posset. Globus autem ille, malleis percussus ad utrumque polum, ad planisphærium magis et magis appropinquabat. Atque sub primis contusionibus facilius cedebat, postea pro modo condensationis, ægrius; ut ad extremum mallei non multum proficerent; sed pressorio, eoque forti, opus esset. Verum id præcepimus, ut a pressuris aliqui dies interponerentur, quod in præsentia nihil attinet, sed alio spectat.

Aër in vasa clausa exsuctione forti extenditur seu dilatatur, adeo ut parte aëris sublata, reliquus aër tamen eandem mensuram impleat quam totus impleverat; ita tamen ut magna contentione se restituere et ab illa tensura liberare nitatur. Id videre est in ovis, quæ aquam odoratam continent et per lusum jaciuntur et franguntur, ut adspersione et odore suavi aërem imbuant. Modus autem est, ut parvo admodum facto in extremo ovi

foramine, ovi cibum universum exsugant, integra testa; tum vero fortiter aërem ipsum qui subintravit exsuctione forti alligant,[1] et statim sub exsuctione digito foramen obturent, atque ovum hoc modo clausum subter aquam illam ponant, et tum demum digitum amoveant. Aër vero tensura illa tortus, et se recipere nitens, aquam trahit et introcipit, quousque portio illa aëris antiquam recuperet consistentiam.

Nos idem cum ovo vitreo experti sumus, et aquam receptam circa octavam partem contenti reperimus; tantum scilicet aër per exsuctionem erat extensus. Sed hoc pro violentia majore aut minore exsuctionis casum recipit. Sub finem vero exsuctionis labrum ipsum trahebat. Sed præterea cura nobis fuit novi experimenti, nimirum ut, postquam exsuctio facta fuisset, foramen cera bene obturaretur, et ovum ita obturatum per diem integrum maneret. Id eo fecimus, ut experiremur ut mora illa appetitum aëris minueret, ut fit in rebus consistentibus, viminibus, laminis ferreis, et similibus, quorum motus ad se recipiendum a tensura mora elanguescit; sed comperimus tantula illa mora nihil effectum, quin ovum illud æque fortiter ac similem traheret aquæ quantitatem, ac si continuo ab exsuctione immissum esset; adeo ut etiam foramine illius aperto extra aquam novum aërem cum sonitu et sibilo manifesto traheret: sed effectum ulterioris moræ experiri negleximus.

In follibus, si nullum detur spiraculum, et subito folles eleventur et aperiantur, franguntur; scilicet cum attrahi non possit per rostri follium angustias tanta aëris quantitas, quæ ventrem a plano in altum subito surgentem implere possit, nec aër qui adest in tantum extendi; unde sequitur follium effractio.

[1] So in the original.

Historia.

Si aqua accipiatur in vitro ad mensuram justam, et locus usque quem aqua adscenderit signetur, et immittatur in aquam cinis communis per cribrum mundatus, et permittatur donec resederit; videbis spatium in fundo cinere occupatum adscendere quadruplo altius, quam corpus aquæ superficie adscenderit a loco prius signato; ita ut manifestum sit, aquam cum cinere commistam, aut sphæram mutare et se contrahere, aut cinerem intra cava aquæ recipere, cum nullo modo se expandat pro ratione cineris recepti. Verum si hoc in arena vel tenuissima (sed neutiquam calcinata aut combusta) experieris, videbis aquam surgere in superficie, pari spatio ac arena surrexerit in fundo. Existimamus etiam infusiones plerasque aquas onerare, neque tamen extendere pro mole corporis recepti; verum hujus rei experimentum omisimus.

Monitum.

Motum successionis, quem motum ne detur vacuum appellant, nullo modo cum motu receptionis a tensura confundimus. Sunt enim duo isti motus tempore et opere conjuncti, ratione diversi, ut in propria historia ejus motus patebit.

Aër per respirationem receptus exigua mora ita naturam vaporis induit, ut et speculum caligine quadam, et tanquam roscida materia obducat, et frigore brumali circa barbam congeletur. Illa autem irroratio supra laminam ensis lucidam, aut adamantem, instar nubeculæ dissipatur, ut corpus politum se veluti expurget.

Modus processus aquæ circa expansionem et contractionem quæ fiunt in ejus corpore mediante igne, hujus-

modi est. Aqua modico calore lacessita vaporem paucum et rarum emittit, antequam intra corpus ejus alia conspiciatur mutatio; deinde continuato et aucto calore, corpore tamen integro, non insurgit, nec etiam bullis minutioribus in modum spumæ effervescit, sed per bullas majores adscendens in vaporem copiosum se solvit, cito autem evolat aqua et absumitur. Atque vapor ille, si non impediatur, aëri se miscet; primum conspicuus, etiam postquam conspectum effugerit sensibilis, vel odorem fundendo vel etiam aërem ad tactum et anhelitum humectando et leniendo. Tandem vero intra pelagus illud aëris se condit et disperdit. Quod si prius occurrat corpus solidum (et eo magis si æquale fuerit et politum), vapor ille se ipse subingreditur, et in aquam restituitur excludendo sive excernendo aërem qui prius vapori immistus fuerat. Atque universus ille processus et in decoctione aquæ, ut in destillatione fit manifestus. Sed porro videmus vapores qui a terra emittuntur, si penitus a calore solis dissipati atque edomiti non fuerint, neque ab aëris frigore fortasse corpori ipsi aëris æqualiter commisti, licet corpori solido non occurrant, tamen a frigore et ipsa caloris destitutione in aquam restitui; ut in rore vespertino præsentius, in pluviis tardius fit. Ex æstimatione eaque diligenti statuimus, expansionem aëris, si ad aquam conferatur, ad rationem centuplam vicecuplam, aut circiter, accedere.

Historia Exporrectionis Materiæ in Pneumaticis.

Phialam vitream accepimus, quæ unciam fortasse unam capere posset; parvitatem autem vasis duas ob causas experimento convenire existimavimus; unam, quod minore cum calore ad bullitionem properaret, ne forte calore intensiore vesica quæ superimponenda esset

adureretur atque exsiccaretur; alteram, ut minorem portionem aëris in ea parte quæ aqua implenda non esset caperet; cum ipsum aërem extensionem per ignem suscipere probe cognossemus. Itaque ut illa extensio rationes aquæ minus disturbaret, non multum aëris adhiberi consultum putavimus. Phiala autem erat ejus figuræ, non quæ collum rectum haberet sine limbo sive labro (nam in hujusmodi phiala aquæ vapor citius destillaret, et in partem vesicæ collo phialæ conjunctam ros incumberet et delaberetur), sed quæ collum haberet paululum primo adductum, et deinde tanquam reversum cum labro. Hanc phialam ad dimidiam, non amplius (existimantes hoc etiam ad celeritatem bullitionis conferre), aquâ implevimus, atque pondus aquæ cum phiala ipsa exacte notavimus per arenam in bilance immissam; deinde vesicam accepimus quæ circiter pintam dimidiam contineret. Eam accepimus non veterem neque siccam, et per siccitatem magis renitentem, sed recentem et molliorem; vesicam autem primo in sufflando probavimus an integra esset, ne forte foramina haberet; postea ex eadem aërem omnem, quoad fieri potuit, expressimus. Etiam prius vesicam oleo extra oblivimus, et oleum quoque fricatione nonnulla recipi fecimus. Hoc eo pertinebat ut vesica clausior esset, ejus si qua erat porositate oleo obturata. Hanc vesicam circa os phialæ, ore phialæ intra os vesicæ recepto, fortiter ligavimus, filo parum cerato, ut melius adhæresceret et arctius ligaret. Sed hoc ipsum melius fit luto ex farina et albumine ovi facto, et cum papyro nigra ligato et bene siccato, ut experti sumus. Tum demum phialam supra carbones ardentes in foculo collocavimus. Aqua non ita multo post bullire incepit, ac paulatim vesicam ex omni parte sufflare, et fere ad rupturam usque ex-

tendere. Continuo vitrum ab igne removimus, et super tapetem posuimus, ne frigore vitrum disrumperetur; et statim in summitate vesicæ foramen acu fecimus, ne vapor cessante calore in aquam restitutus recideret, ac rationes confunderet. Postea vero vesicam ipsam cum filo sustulimus; lutum autem si adhibitum fuerat, expurgavimus; tum rursus aquam quæ remanserat cum phiala sua ponderavimus; comperimus autem circiter pondus duorum denariorum per vaporem absumptum fuisse. Quicquid autem corporis vesicam cum sufflata esset impleverat, ex illo quod de aqua perditum fuerat factum et productum fuisse cognovimus. Itaque materia cum in corpore aquæ contracta fuisset, tantum implebat spatii quantum pondus 2 denariorum corporis aquæ implebat; at eadem materia in corpore vaporis expansa dimidiam pintam implebat. Itaque secundum dimensionem in Tabula expressam rationes subduximus; vapor aquæ ad corpus aquæ habere potest rationem octogecuplam. Vesica eo quo diximus modo sufflata, si nullum detur spiraculum, sed integra ab igne removeatur, statim ab inflatione illa decrescit, et subsidet, et contrahitur. Vapor dum vesica turget ex foramine emissus, aliam fere speciem a vapore communi aquæ habebat, magis raram et perspicuam, et erectam, nec cum aëre tam cito se miscentem.

Monita.

Ne quis putet, si major fuisset aquæ absumptio, tanto majorem vesicam impleri potuisse; nobis enim hoc expertis res non successit, sed inflatio quæ fit, fere confertim fit, nec gradatim. Id partim adustioni vesicæ tribuimus quæ facta est obstinatior nec cedebat facile, et erat forte porosior (hoc vero calore humido, ut balneo

Mariæ, corrigi poterat); sed illud magis in causa esse putamus, quod vapor copiosior factus per successionem continuam, vergit ad restitutionem, et se ipse condensat. Itaque nec est æquiparandus vapor iste qui in vesicam recipitur, vaporibus qui intra clibana[1] recipiuntur; quia illi se mutuo subsequentes et trudentes densant, isti vero a vesicæ mollitie et cessione, præsertim sub initiis (ut diximus) antequam copia restitutionem incitet, se expandunt ut volunt.

Expansio vaporis aquæ omnino non est judicanda ex adspectu vaporis qui in aërem evolat; ille enim vapor statim cum aëre mistus longe maximam corporis misti dimensionem ab aëre mutuatur, nec sua stat mole. Itaque amplificatur ad molem quampiam aëris in quem recipitur, ad exemplum parvæ portionis vini rubei, aut alterius rei infectæ et coloratæ, quæ magnam quantitatem aquæ tingit. Rationes exactæ in tanta subtilitate, nec sine inutili et curiosa indagine haberi possunt, nec ad id quod agitur magnopere juvant. Satis est, ut pateat ex hoc experimento, rationem vaporis ad aquam non esse duplam, non decuplam, non quadragecuplam, non rursus millecuplam, non ducentuplam etc. Termini enim naturarum, non gradus, in præsentia investigantur. Itaque si quis suo experimento in rationem istam octogecuplam (vel propter figuræ vitri differentiam, vel propter vesicæ duritiem aut mollitiem, vel propter caloris modum) non incidat, id rem nullius esse momenti sciat. Nemo erit (existimamus) tam imperitus, qui putet pneumatica et volatilia quæ ex corporibus ponderosis evolant, latere in poris eorundem corporum, nec esse illam ipsam materiam quæ ponderosa erat; sed a ponderosa parte separari, cum aqua quasi

[1] *Clibona* in the original. I believe it ought to be *clibanos*.

tota consumatur, et ad nihilum evaporet. Pruna ardens si in bilance ponatur, et usque ad extinctionem permittatur ut sit carbo, longe levior invenietur. Metalla ipsa per evolationes fumorum pondere insigniter mutantur. Itaque prorsus eadem materia numero tangibilis est et pondere dotatur, et fit pneumatica et pondus exuit.

Historia.

Modus processus olei talis est; si accipiatur oleum in phiala vitrea vulgari, et ponatur super ignem, tardius multo bullire incipit, et majorem calorem ad hoc ut bulliat desiderat, quam aqua. Ac primo guttulæ quædam aut granula per corpus olei sparsa apparent, adscendentia cum crepitatione quadam; interim nec bullæ in superficie ludunt, ut in aqua fit, nec corpus integrum mole insurgit, nec quicquam fere halitus evolat, sed paulo post corpus integrum inflatur et dilatatur proportione notabili, tanquam ad duplum insurgens. Tum demum copiosissimus et spissus evolat halitus: ad illum halitum si flamma admoveatur, etiam bono spatio supra os phialæ, flammam halitus continuo concipit, atque statim ad os phialæ descendit, atque ibi se figit, et perpetuo ardet. Quod si etiam majorem in modum calefactum fuerit oleum, ad extremum halitus ille extra vitrum flammans, absque flamma aut corpore aliquo ignito admoto, prorsus se ipse inflammat et expansionem flammæ induit.

Monitum.

Videndum est ut phiala sit oris angustioris, ut fumos constringat, ne aëri se statim ac largiter miscentes naturam inflammabilem deponant.

Historia.

Modus processus spiritus vini talis est. Ille minore multo calore excitatur[1] et celerius ad expansionem se comparat, eamque præstat, quam aqua. Ebullit autem magnis utique bullis, absque spuma aut etiam totius corporis elevatione; vapor autem ejus dum confertus est, in bona ab ore vitri distantia flamma admota flammam concipit, non tam lucidam certe et bene compactam quam oleum, sed tenuem et jejunam, cœruleam quoque et fere perspicuam. Inflammatus autem fertur ad os vitri, ubi pabuli magis copiosi datur subministratio, quemadmodum et oleum. Verum tamen si inflammetur vapor in parte ab ore vitri nonnihil deflectente in obliquum, fit inflammatio in aëre pensilis, undulata, aut arcuata, imaginem vaporis secuta, et proculdubio longius ipsum comitatura, si vapor ille constipatus maneret, nec cum aëre se confunderet. Atque corpus ipsum spiritus vini, nullo præcedente vapore notabili, flamma admota et parum immorante, in flammam ejusque expansionem mutatur, eo citius et facilius, quo spiritus latius diffusus sit et minorem occupet altitudinem. Quod si spiritus vini in cavo palmæ manus ponatur, et candela accensa inter digitos juxta palmam collocetur (ut pueri cum pulvere resinæ ludere solent), et spiritus ille leviter projiciatur, et prorsum non sursum directo; ardet corpus ipsum in aëre, et accensum interdum descendit recta; interdum nubeculam in aëre volitantem explicat, quæ tamen ipsa ad descensum vergit; interdum ad tecti fastigium, vel latera, vel pavimentum, utique inflammatum, adhærescit et ardet, et sensim extinguitur.

[1] *excitatus* in the original.

Habent autem acetum, agresta, vinum, lac, atque alii liquores simplices (ex vegetabilibus et animantibus, dico, nam de mineralibus seorsim memorabimus) suos expansionum modos, atque in iis notabiles nonnullas differentias, quas hoc loco referre supervacuum visum est. Versantur autem istæ differentiæ in illis naturis, quas in processibus aquæ et olei et spiritus vini notavimus; gradu nempe caloris; et modo expansionis, quæ triplex est; vel toto corpore, vel spuma, vel bullis majoribus. Nam pinguia fere toto corpore; succi immaturi, ut agresta, bullis majoribus; succi effœti, ut acetum, minoribus, adscendunt. Etiam congregatio spiritus situ differt. Nam in vini bullitione bullæ circa medium, in aceto circa latera, se congregare in ebullitione primo incipiunt; quod etiam in vino maturo, et forti, et vapido rursus aut fugiente, cum infunduntur, fieri solet.

Omnes autem liquores, etiam oleum ipsum, antequam bullire incipiunt, paucas et raras semibullas circa latera vasis jaciunt. Atque illud etiam omnibus liquoribus commune est, ut parva quantitate citius bulliant et absumantur, quam magna.

Monitum.

Liquores manifeste compositos, ad historiam expansionis et coitionis materiæ mediante igne, haud idoneos aut proprios existimavimus, quia separationibus et misturis suis rationes simplicis expansionis et coitionis disturbant et confundunt. Itaque illos ad propriam historiam separationis et misturæ ablegavimus.

Historia.

Spiritus vini in experimento positus cum pileo illo

tensibili (quem cum de aqua loqueremur descripsimus) hujusmodi sortitus est expansionem. Comperimus pondus 6 denariorum consumptum et in vaporem solutum, vesicam grandem quæ 8 pintas capere posset, explevisse et fortiter inflasse; quæ vesica decuplo-sextuplo erat major quam vesica illa qua ad aquam usi sumus, quæ dimidiam pintam tantum recipiebat. Sed in experimento aquæ ponderis solummodo 2 denariorum facta erat consumptio; quæ tertia tantum pars est denariorum sex. Ita supputatis rationibus, expansio vaporis spiritus vini ad expansionem vaporis aquæ quintuplam rationem habet, et amplius. Neque tamen obstabat immensa ista expansio, quin, vase ab igne remoto, corpus ad se restituendum properaret, vesica continuo flaccescente,[1] et se insigniter contrahente. Atque ex hoc experimento corporis flammæ expansionem æstimare cœpimus, conjectura non admodum firma, et tamen probabili. Cum enim vapor spiritus vini res sit tam inflammabilis, atque ad naturam flammæ tam prope accedat, judicavimus rationes vaporis spiritus vini ad flammam, cum rationibus vaporis aquæ ad aërem convenire. Quales enim se ostendunt rationes rudimentorum, sive corporum imperfectorum et migrantium (vaporum scilicet), tales etiam evadere corporum perfectorum et statariorum (flammæ scilicet et aëris) consentaneum est. Ex quo sequetur, flammam aërem raritate sive expansione materiæ quintuplo et amplius superare. Tanto enim se invicem superant vapores sui, ut dictum est; flamma vero ipsa ad proprium vaporem, non impurum sed summe præparatum, sesquialteram rationem habere potest, ut aërem item ad vaporem aquæ summe præparatum habere posuimus.

[1] *flavescente* in the original.

Neque hæc multum discrepant ab iis quæ visu obiter percipiuntur, et familiariter occurrunt. Nam si candelam ceream accensam flatu extinguas, et fili illius fumei qui adscendit (in ima parte antequam dispergatur) dimensionem animadvertas; et candelam prope flammam admoveas, et rursus portionem flammæ quæ primo allabitur contempleris; eam fumi magnitudinem non multo plus quam duplo excedere judicabis; et tamen ille fumus impurior est et pressior. Quod si pulveris tormentarii corporis dimensionem diligenter notes, aut ad meliorem conjecturam in situla metiaris, atque rursus, postquam flammam corripuerit, dimensionem flammæ suæ advertas; flammam corpus (quomodo hujusmodi res subito intuitu comprehendi possit) mille vicibus superare, non admodum negabis. Atque hujusmodi quædam proportio flammæ ad nitrum, ex iis quæ prius posuimus, debetur. Verum de his, cum ad observationes nostras super hanc historiam ventum erit, clarius explicabimus.

Aërem ipsum expandi et contrahi ex calore et frigore, in ventosis quibus utuntur medici ad attractionem luculenter videmus. Illæ enim super flamma calefactæ et continuo ad carnem applicatæ, carnem trahunt, contrahente se et restituente paulatim aëre. Atque hoc operatur ex sese, licet stuppa immissa atque inflammata non fuerit, qua ad vehementiorem attractionem uti solent. Quinetiam si spongia frigida infusa ventosis superimponatur exterius, tanto magis se contrahit aër virtute frigoris, et fortior fit attractio.

Salinum argenteum, quale forma campanili vulgatissima ad mensæ usum adhibemus, in lavacro aut patera aqua plena collocavimus, aërem depressum secum una ad vasis fundum vehens. Tum prunas ardentes duas

aut tres in concavo illo parvo quod salem excipere solet posuimus, atque ignem a flatu excitavimus. Evenit autem non multo post, ut aër per calorem rarefactus, et antiquæ sphæræ impatiens, salini fundum ex aliquo latere elevaret, et in bullis adscenderet.

Hero describit altaris fabricam, eo artificio, ut superimposito holocausto et incenso, subito aqua decideret, quæ ignem extingueret. Id non aliam poscebat industriam, quam ut sub altare loco cavo et clauso aër reciperetur, qui nullum alium (cum ab igne extenderetur) inveniret exitum, nisi qua aquam in canali ad hoc paratam impelleret et extruderet. Erant etiam Batavi quidam nuper apud nos, qui organum quoddam musicum confecerant, quod radiis solis percussum symphoniam quandam edebat. Id ab aëris tepefacti extensione, quæ principium motus dare potuit, factum fuisse verisimile est; cum certum sit aërem, vel exigui admodum caloris contactu lacessitum, expansionem statim moliri.

Verum ad magis accuratam expansionis aëris notitiam, ad vesicam illam sensibilem versi, vitrum accepimus vacuum (scilicet aëre solo impletum); ei pileum illum ex vesica (de quo jam antea locuti sumus) imposuimus. Vitro autem super ignem imposito, celerius et minore calore se extendebat aër, quam aqua aut spiritus vini; sed expansione non admodum ampla. Hanc enim proportionem ferebat: si vesica ex semisse minoris contenti erat quam vitrum ipsum, aër illam fortiter sane et plene inflabat; ad majorem expansionem non facile adscendebat; foramine autem in summitate vesicæ, dum inflaretur, facto, nullum exibat corpus visibile.

DESCRIPTIO

GLOBI INTELLECTUALIS

ET

THEMA CŒLI.

PREFACE

TO THE

DESCRIPTIO GLOBI INTELLECTUALIS.

THIS tract, published by Gruter in 1653, must have been written about 1612. This follows from what is said of the new star in Cygnus,[1] which was first observed in 1600. It is therefore intermediate in date between the *Advancement of Learning* and the *De Augmentis;* and though on a larger scale than either, it is to be referred to the same division of Bacon's writings. The design of all three is the same, namely, a survey of the existing state of knowledge. The commendation of learning which forms the first book of the other two works being in this one omitted, it commences with the tripartite division of knowledge which Bacon founded on the corresponding division of the faculties of man — memory, imagination, and reason. History, which corresponds to memory, is here as in the *De Augmentis* primarily divided into natural and civil, whereas in the *Advancement* the primary division of history is quadripartite, literary and ecclesiastical history being made co-ordinate with civil history, instead of being as here subordinated to it.

[1] Stella nova in pectore Cygni . . jam per duodecim annos integros duravit.

The divisions of natural history are then stated, and are the same as in the *De Augmentis;* and the remainder of the tract relates to one of these divisions, namely the history of things celestial, or in other words to astronomy. The problems which it should consider, and the manner in which they ought to be solved, are treated of at some length; but even with respect to astronomy much which it is proposed to do is left undone, the whole tract being merely a fragment.

Bacon has nowhere else spoken so largely of astronomy; the reason of which apparently is, that he was writing just after Galileo's discoveries had been made known in the *Sydereus Nuncius*, published in 1611; a circumstance which makes the *Descriptio Globi Intellectualis* one of the most interesting of his minor writings. The oracles of his mind were in this case evoked by the contemplation, not of old errors, but of new truths.

The *Thema Cœli*, which contains a provisional statement of his own astronomical opinions, is immediately connected with the astronomical part of the *Descriptio Globi Intellectualis*. They are clearly of the same date, and form in reality but one work.

In the *De Augmentis* Bacon has expressed the same general views on the subject of astronomy as in these tracts; and they are in truth views which it was natural for a man not well versed in the phenomena of the science to entertain and to promulgate. What had been done by the old astronomers seemed to him full of useless subtleties and merely mathematical conceptions; men therefore were to be exhorted to cast all these aside, and to study the phenomena of the heavens independently of arbitrary hypotheses. Let us first obtain

an accurate knowledge of the phenomena, and then begin to search out their real causes. Orbs, eccentrics, and epicycles must not stand between the astronomer and the facts with which he has to deal. In this language, which had been held by others, there is something not wholly untrue; yet the counsel which it contains would, if it could have been followed, have put an end to the progress of astronomical science. Let us obtain an accurate knowledge of the phenomena — this no doubt is necessary, but then how is it to be done? To say that instead of trying to resolve the motion of the planets into a combination of elementary circular motions, we ought to be content to save the appearances by means of spirals, is to no purpose unless we are prepared to give an accurate definition of the kind of spiral we mean. Failing this, a statement that the apparent path of a planet is a spiral or irregular line along which it moves with varying velocity, is much too vague to be of any scientific value whatever; and if we seek to give precision to this statement, we find ourselves led back again into the region of mathematical conceptions, or, if the phrase be preferred, of mathematical hypotheses. The distinction between what is real and what is only apparent lies at the root of all astronomy; and it is in vain to seek for a physical cause of that which has only a phenomenal existence, as for instance of the stations and regressions of the planets. Thus in two points of view, astronomy must of necessity employ mathematical hypotheses, firstly in order to the distinct conception of the phenomena, and secondly in order to be able to state the problems which a higher science is afterwards to solve. If the hypotheses employed are inappropriate, as in the systems of

Ptolemy or Tycho Brahe, they may nevertheless have done good service in making it possible to conceive the phenomena, and moreover may serve to suggest the truer views by which they are to be replaced. Almost any hypothesis is better than none, "citius enim," as Bacon has elsewhere said, "emergit veritas ex errore quam ex confusione." The wrong hypotheses doubtless lead to premature speculation touching physical causes; but this is a mischief which in course of time tends to correct itself, as we see in the Ptolemaic system, of which the overthrow was in good measure due to the cumbrous machinery of solid orbs which had been constructed to explain the motions mechanically. It came to be seen that even if this system could save the phenomena, it was unable to give a basis on which a just explanation of their causes could be founded.

I have said that almost any hypothesis is better than none. But the truth is that as soon as men begin to speculate at all an hypothesis of some kind or other is a matter of necessity. On merely historical grounds and apart from any consideration of the relation between facts and ideas, questions might be propounded to a writer who was trying to describe the phenomena of the heavens without introducing any portion of theory, to which he would not find it easy to give clear answers. Thus we know that one of the philosophers of antiquity affirmed that the sun is new every day;—are you prepared, we might ask, to set aside the authority of Heraclitus, and to maintain your theory in opposition to his? If you affirm that the sun which set last night is the same as that which rose this morning, you are no longer a describer of phenomena, but, like those whom you condemn, a dealer in hypotheses.

However this difficulty is got over, you will at any rate not venture to confound Hesperus and the morning star. It is true that one of the great teachers of Greece long since asserted that they are the same; but the speculative fancies of Pythagoras must be rejected not less than those of Ptolemy or Regiomontanus.

We find that Bacon, both in the *De Augmentis* and in the following tract, speaks of the constructions of astronomy as purely hypothetical. In this he agrees with many other writers. It was a common opinion that these constructions had no foundation in reality, but were merely employed as the basis of mathematical calculations. They served to represent the phenomena, and that was all. This view, which has not been without influence on the history of astronomy, inasmuch as it made the transition from one hypothesis to another more easy than it would have been if either had been stated as of absolute truth, connected itself with a circumstance not unfrequently overlooked. The struggle between the peripatetic philosophers and the followers of Copernicus has caused an earlier struggle of the same kind to be forgotten. The Ptolemaic system is in reality not much more in accordance with the philosophy of Aristotle than the Copernican; and therefore, while the authority of Aristotle was unshaken, it could only be accepted, if accepted at all, as a means of representing the phenomena. The motions of the several orbs of heaven must, if our astronomy is to accord with Aristotle, be absolutely simple and concentric. On these conditions only can the incorruptibility of the heavens be secured. Consequently eccentrics and epicycles must be altogether rejected; and as the Ptolemaic system necessarily employs them, it follows that

this system is only of value as a convenient way of expressing the result of observation. Such was the view of those who, while they adopted Aristotle's principles, were aware that the astronomical system with which he was satisfied, and of which he has given an account in the twelfth book of the *Metaphysics*, was wholly inadequate as a representation of the phenomena. But his more strenuous adherents went further, and followed Averroes in speaking with much contempt of Ptolemy and of his system; an excess of zeal which Melancthon, in the spirit of conciliation which belongs to his gentle nature, has quietly condemned.[1]

Out of this antinomy, if the word may be so used, sprang several attempts to replace the Ptolemaic system by a construction which should be in accordance both with the phenomena and with Aristotle. Of these the best known is the Homocentrica of Fracastorius. As the name implies, all the orbs have on this hypothesis the same centre, and of these homocentric orbs he employs seventy-seven. But a fatal objection to this and all similar attempts is that they can give no explanation of changes in apparent distance. Fracastorius tries to set aside this objection by asserting that although the distance of some of the heavenly bodies from the earth may seem to vary, yet it never does so in reality, the apparent variation being caused by the varying medium through which they are seen.

Though this explanation is wholly unsatisfactory, the wish to get rid of eccentrics and epicycles was sufficiently strong to win for Fracastorius a much more favourable reception than his complex and imperfect hypothesis deserved. He was spoken of as a man who

[1] See Initia Physicæ.

had succeeded in overcoming the divorce which had so long separated astronomy from philosophy.[1]

Of the similar attempt made by D'Amico I know no more than what is mentioned by Spiriti in his *Scrittori Cozentini.*

The Ptolemaic system being thus treated as a mere hypothesis by the followers of Aristotle, for of course the astronomers who accepted Purbach's theory of solid orbs must have regarded it as a reality, it was natural that Bacon should have thought that what we now call physical astronomy, that is the causal explanation of the phenomena, ought to be studied independently of this system. Whatever it had accomplished might be as well done without it. Spirals and dragons would be found sufficient to represent the phenomena, if the perverse love of simplicity which had led the mathematicians to confine themselves to circles and combinations of circles was once got rid of. Galileo's view of this matter is however undoubtedly the true one, "Le linee irregolari son quelle che, non avendo determinazion veruna sono infinite e casuali, e perciò indefinibili, nè di esse si può in conseguenza dimostrar proprietà alcuna, nè in somma saperne nulla; sicchè il voler dire, il tale accidente accade mercè di una linea irregolare, è il medesimo che dire io non so perchè ei si accagia."[2]

Bacon was not the first who proposed to sweep away from astronomy the mathematical constructions by which it seemed to be encumbered. We find in Lucretius nearly the same views as those of Bacon. The

[1] See Flaminius. [Carmin. lib. ii. f. 30. *Ed. Lutet. per Nicol. Divitem.*] It is remarkable that Delambre declares that he cannot see why Fracastorius should have thought his own system better than the old one. The reason is perfectly obvious if we consider the matter in connection with the history of philosophy.

[2] Saggiatore, ii. p. 187.

astronomers, Bacon often says, insist on explaining the retardation of the inferior orbs by giving them a proper motion of their own, opposite to that which they derive from the starry heaven: surely it would be simpler to say that all the orbs move in the same direction with unequal velocities; the inequality depending on their remoteness from the prime mover.

Compare with this the following lines of Lucretius:—

> "Quanto quæque magis sint terram sidera propter,
> Tanto posse minus cum cœli turbine ferri:
> Evanescere enim rapidas illius, et acreis
> Imminui subter, vireis; ideoque relinqui
> Paullatim solem cum posterioribu' signis,
> Inferior multum quum sit quam fervida signa:
> Et magis hoc lunam;" &c.[1]

But it was probably not from Lucretius that Bacon derived this way of considering the matter. For Telesius, whom Bacon esteemed "the best of the novelists," and whose pastoral philosophy, as he has not unhappily called it, was contented with vague speculations as to the causes of phenomena without any accurate knowledge of their details, had suggested to his followers that it was nowise necessary to resolve the motion of the sun into the motion of the starry heaven and the motion of his own orb, and that on the contrary this composition of motions is unintelligible. You may see, he affirms, with your own eyes the way in which the sun, moving with one motion only, advances continually from east to west, and alternately towards the north and south; all that is necessary is to admit that the poles on which he revolves are not constantly at the same distance from the poles of heaven, but on the contrary are always receding from or advancing towards them.[2]

Amongst those who called themselves Telesians the

[1] *Lucret.* v. 622. [2] Telesius, De Rer. Nat. iv. 25.

view here suggested received a fuller development; they adopted the doctrine of Alpetragius, a Latin translation of whose *Theorica Planetarum* was published at Venice in 1531. Alpetragius professes that he found the complication of the Ptolemaic system intolerable, and that the foundation of his own is much simpler. "Apparet sensu quod quilibet planeta revolvitur singulo die super circulis æquidistantibus ab æquinoctiali; attamen diuturnitate temporis et revolutione planetæ multis revolutionibus ex periodis diurnis, videtur ille planeta moveri a puncto in quo visus est primum æquinoctialis et respectu motus similis ei postponi in longitudine et declinare a suo primo loco in latitudine," of which the reason is that it does not really revolve in circles parallel to the equator, "sed est revolutio girativa dicta laulabina ex declinatione planetæ a loco suo in latitudine."[1] Of this the reason is twofold: the planet's orb moves more slowly than the prime mover in consequence of its essential inferiority, an inferiority which increases in the case of different planets with their nearness to the earth; and its poles revolve on two small circles parallel to the equator. Alpetragius goes on to apply these hypotheses to each of the planets. It is needless to point out of how little value his speculations necessarily are. Such as they are however, the Telesians, as we learn from Tassoni,[2] were content to accept them. Of the astronomical writings of the Telesians I have not been able to find any account. None of those who are mentioned by Spiriti appear to have published anything on the subject. However this may be, the authority of Tassoni is sufficient to show that the school of Telesius rejected the Ptolemaic system and especially the notion that the planets &c. have a proper motion

[1] Alpetragius, fo. 14. v. [2] Pensieri diversi, ii. 4. (Venice, 1636.)

from west to east; and that their views are therefore in accordance with those which Bacon propounds in the *Thema Cœli*, so far at least as relates to the general conception of the planetary motions.

Patricius, on whom the influence of Telesius is manifest, and who furnished Bacon with many of the facts contained in the following treatises, also rejected, and more contemptuously than Telesius, the common astronomical hypotheses. The planetary motions, their stations and regressions are, he says, explained by astronomers by the help of epicycles and eccentrics; but we ascribe them to the natures and spirits of the planets, and in a higher degree to their souls and minds. Of this idle talk Gilbert remarks that it destroys the study of astronomy. "Quid autem," he observes, "tum postea spectabit otiosus incassum philosophus, opinione suâ satiatus, cœlum sine usu sine motuum prævidentiâ: ita nullius usus erit illa scientia."[1] But Patricius's opinions on astronomy could clearly not be of much value, seeing that he was sufficiently ignorant to blame astronomers for not taking into account the distance of the place where their observations are made, from the centre of the earth; and speaks of this omission as "a most evident fallacy:" a remark which proves that he had either never heard of the correction for parallax, or having heard of it was unable to understand its nature.

From him, however, Bacon derived some of the most remarkable statements in the *Descriptio Globi Intellectualis;* particularly the incredible account of the mutations which Venus underwent in 1578. That, setting aside Patricius's loose way of speaking, the real phenomenon was simply that Venus was visible before sun-

[1] Physiol. Nov. ii. 9.

set, is probably the safest explanation of the whole story; of which I have found no mention elsewhere. Thus much however is certain, that there could have been no such peculiarity in her appearance as to suggest to well-informed persons the notion that she had undergone any real change, since in the controversy whether there were any evidence of corruption or generation in the heavens a fact like this could not have been passed over.

Of the discoveries announced by Galileo in the *Sydereus Nuncius* Bacon does not speak at much length, though it is difficult not to believe that he was led to say so much of astronomical theories by the interest which these discoveries must have excited when they were first made known. The discovery of Jupiter's satellites, the resolution into stars of the nebula Præsepe, and the irregularities in the moon's surface, are all mentioned in the following tract; but, as I have said, somewhat briefly.[1]

It is remarkable that neither in the following tracts nor in his subsequent writings has Bacon mentioned the discoveries of Kepler. The treatise *De Stellâ Martis* was published in 1609, and became known in England at least as early as 1610. Harriot, it appears from Professor Rigaud's account of his papers, was then in correspondence with him, and repeated his calculations.

[1] The interest which these discoveries excited must have been very great. Sir William Lower writes to Harriot, "I gave your letter a double welcome, both because it came from you and contained news of that strange nature . . . Methinks my diligent Galileus hath done more in his threefold discovery than Magellane in opening the straits to the South Sea, or the Dutchmen that were eaten by bears in Nova Zembla." The news had just reached him. His date is "the longest day of 1610." It had taken rather more than three months to travel from Italy to Wales. — *Professor Rigaud's Supplement*, &c., p. 26.

That Bacon was acquainted with his writings we can hardly believe; they bear so directly on the questions which he has discussed that he could scarcely have neglected to notice them, had he known them even by report. In the very first page of Kepler's great work we find a quotation from Peter Ramus, declaring that he would resign his professorship in favour of any one who should produce an astronomy without hypotheses. To this Kepler subjoins an apostrophe to Ramus, telling him that it is well that death had relieved him of the necessity of redeeming his pledge, and vindicating Copernicus from the charge of having explained the phenomena of astronomy by unreal hypotheses. The same subject is resumed in the preface, and elsewhere throughout the book. Again, in another point of view, it makes Bacon's complaints that astronomers cling superstitiously to perfect circles appear somewhat out of date, to find that before the time at which he wrote the man who confessedly both by his genius and his official position stood at the head of the astronomers of Europe and, so to speak, represented them, had succeeded in saving the phenomena more accurately than had been done before, by means of ellipses. A great change had just taken place; two most remarkable laws, the foundations of modern physical astronomy, had just been propounded, namely the law of elliptic motion, and that of the equable description of areas; and the whole state of the question with respect to the truth or falsehood of the Copernican system was thus changed. In truth this system was inextricably connected not only with Kepler's results, but with his method. In his dedication to the Emperor he says, "Locum (that is, the place of Mars) indagine cinxi, curribus magnæ

Matris Telluris in gyrum circumactis." He means by this that he used observations of Mars made when in the same point of his orbit, the earth being at the time of the different observations in different points of hers. The same idea of the connexion of the Copernican hypothesis with Kepler's method, is expressed in one of the complimentary stanzas prefixed to the book: —

Cœlos Keplerus terrarum oppugnat alumnus:
De scalis noli quærere: terra volat.

In one of Kepler's letters to David Fabricius, nothing can be more decided than his rejection of the notion that all motions of the heavenly bodies are in perfect circles. "Quod ais non dubium quin omnes motus fiant per circulum perfectum, si de compositis (id est de realibus) loqueris, falsum: fiunt enim Copernico, ut dixi, per orbitam ad latera circuli excedentem, Ptolemæo et Braheo insuper per spiras. Sin autem loqueris de componentibus, de fictis igitur hoc est de nullis loqueris. Nihil enim in cœlo circumit præter ipsum corpus planetæ, nullus orbis, nullus epicyclus: quod Braheanæ Astronomiæ initiatus ignorare non potes." And it is interesting to observe how clearly he distinguishes between the real motions and the component elements into which they may be resolved.

Until the language of modern analysis had enabled us to express the nature and properties of curves merely quantitively, without reference to genesis or construction, it was difficult to attain to a clear way of thinking as to the relation which astronomical hypotheses bear to reality. In order to define the motion which actually takes place, it was necessary to refer to simpler motions which have only an abstract or ideal existence. But then it was asked, how can the result be real if the

elements are not so? In this point of view the unpicturesqueness of symbolical language, though it has led to other inconveniences, has delivered us from a great deal of confused thinking. If Poinsot's illustration of the motion of a rigid body by means of a central ellipsoid rolling on a fixed plane, had been proposed at the beginning of the seventeenth century, most people would have said that the hypothesis was absurd, though it might correspond to the phenomena.

To take the matter more generally, it must be remembered that positive truth or falsehood belongs only to the region of the actual and individuated. To say that two and three make five is not to deny that four and one do so too, although if I assert that of five houses, first three were built and then two added, I contradict the assertion that four were built at first and that only one is of later date. Not merely in the relation between cinematical or formal and physical astronomy, but generally, the question whether an hypothesis be true or false does not arise unless it is presented as a causal explanation. Thus when Berosus taught that one half of the moon is luminous, and that her phases arise from this half being always turned towards the sun in virtue of their mutual sympathy, both being bright, the explanation is unexceptionable, except so far as relates to the efficient cause. One half of the moon always is bright; and always is turned to the sun; and this Berosus saw as clearly as we do. It is in this way that false hypotheses are transformed into true ones; not by the transformation of anything false into truth, but by the severance of the causal or real element from that which is neither true nor false, namely the abstract conception. But the interest

of the subject has led me to dwell on it at too much length.

It is curious to observe that in the interval between the composition of the following tracts and that of the *De Augmentis* Bacon's leaning against the Copernican system became more decided, though in the same interval the system had received an accession of strength, of which doubtless he was not aware, in the discovery of Kepler's third law.[1] This law, connecting as it does the planets with the sun by an uniform relation which is fulfilled also by the earth, is in some respects the most remarkable of the three, and points the most directly to the sun as the great centre of our system. No doubt neither this law, nor all three together, amounts to a positive demonstration: it has sometimes been forgotten that after all they are but approximations to the truth; but of all approximations these laws are the most remarkable, and it would be very difficult to doubt, even without the knowledge we now possess, that they are grounded on a physical basis. This basis is their correspondence with a causal or physical approximation. They would be absolutely true if the lesser bodies of

[1] This discovery was made, as Kepler has informed us, on the 15th of May, 1618. In Professor Rigaud's account of Harriot's papers, published in 1833, it is mentioned that Harriot, who was apparently the first person to determine the periods of Jupiter's satellites, committed an error of calculation, in consequence of which that of the first satellite is given at about half its real length, but that Harriot, even before the publication in 1614 of Marius's *Mundus Jovialis*, seems to have suspected his error. The Professor enquires why he did not try his result by means of Kepler's third law, as we know that he was a student of the work in which this law is stated; forgetting that only the first two laws were given in the *De Stellâ Martis*, and that in the interval referred to, between 1610 and 1614, Harriot could no more have known of Kepler's third law than of Newton's *Principia*. But it is really curious that Kepler does not seem to have applied his law to the satellites. The application is said to have been first made by Vendelinus. See Narrien, *Hist. of Astronomy*, p. 398.

the solar system did not attract one another, and if all were attracted by the sun as if he and they were physical points. It would be possible to crowd together a number of epicycles whereby the orbit of the earth would be better represented than on the elliptic hypothesis; but such a system would have no physical significance. No doubt too, all the laws might be true and yet the earth at rest; but we could not adopt such an opinion without doing violence to all our ideas of symmetry and harmony, — ideas which influence our judgments of natural things more than we are aware of. Such a doctrine would be felt "primam violare fidem." We may well believe that had Bacon been acquainted with the discoveries of Kepler, he would not only have been impressed by their astronomical importance, but have felt the full force of the lesson which they convey. He would have felt that they constituted a sufficient reason for transferring the allegiance which had been paid to Mother Earth to a nobler object more justly entitled to the homage which she had so long received. We now know that neither Earth nor Sun is the true Hestia of the old Philosopheme. We know too, that in all the orbs of heaven that we can see or dream of, there can be nothing fully entitled to the appellation, — nothing wholly fixed, or wholly unperturbed. Happy for us if we feel also that there is a Sun of suns whose absolute existence transcends our conceptions of space and time.[1]

[1] Deus, sine qualitate bonus, sine quantitate magnus, sine indigentia creator, sine situ præsens, sine habitu omnia continens, sine loco ubique totus, sine tempore sempiternus, sine ulla mutatione mutabilia faciens, nihilque patiens. — *St. Augustine, De Trin.*

DESCRIPTIO

GLOBI INTELLECTUALIS.

CAPUT I.

Partitio universalis Humanæ Doctrinæ in Historiam, Poësin, Philosophiam, *secundum triplicem facultatem mentis*, Memoriam, Phantasiam, Rationem; *quodque eadem partitio competat etiam in Theologicis: cum idem sit vas (nempe intellectus humanus) licet materia et insinuatio sint diversa.*

PARTITIONEM Doctrinæ Humanæ eam deligimus, quæ triplici facultati intellectus respondeat. Tres itaque ejus partes a nobis constituuntur: Historia, Poësis, Philosophia. Historia ad Memoriam refertur: Poësis ad Phantasiam: Philosophia ad Rationem. Per Poësin autem nihil aliud intelligimus hoc loco, quam historiam fictam. Historia proprie individuorum est; quorum impressiones sunt mentis humanæ primi et antiquissimi hospites; suntque instar primæ materiæ scientiarum. In his individuis, atque in hac materia, mens humana assiduo se exercet, interdum ludit. Nam scientia omnis, mentis et exercitatio et opificium; poësis ejusdem lusus censeri possit. In philosophia mens mancipatur rebus; in poësi solvitur a nexu rerum, et expatiatur, et fingit quæ vult. Hæc vero se ita habere facile quis cernat, qui simpliciter tantummodo et pingui quadam contemplatione intellectualium origines petat. Etenim individuo-

rum imagines excipuntur a sensu, et in memoria figuntur. Abeunt autem in memoriam tanquam integræ, eodem quo occurrunt modo. Has rursus retrahit et recolit mens; atque (quod officium ejus proprium est) portiones earum componit et dividit. Habent enim individua singula aliquid inter se commune, atque aliud rursus diversum et multiplex. Ea vero compositio atque divisio vel pro arbitrio mentis fit, vel proac invenitur in rebus. Quod si fiat pro arbitrio mentis, atque transferuntur portiones illæ ad placitum in similitudinem quandam individui, phantasiæ opus est, quæ nulla naturæ aut materiæ lege et necessitate astricta, ea quæ in rerum natura minime conveniunt conjungere, quæ vero nunquam separantur discerpere potest; ita tamen ut intra primas illas ipsas individuorum portiones coërceatur. Nam eorum quæ nulla ex parte se sensui obtulerunt, non est phantasia, ne somnium profecto. Quod si eædem individuorum portiones componantur et dividantur pro ipsa rerum evidentia et prout vere in natura se produnt aut saltem pro captu cujusque se prodere notantur, eæ partes rationis sunt: atque universa hujusmodi dispensatio rationi attribuitur. Ex quo liquido constat, ex tribus hisce fontibus esse tres illas emanationes Historiæ, Poësis, et Philosophiæ; neque alias aut plures esse posse. Nam sub philosophiæ nomine complectimur omnes artes et scientias, et quicquid denique a singularum rerum occursu per mentem in generales notiones collectum et digestum est. Neque alia censemus ad Doctrinam[1] partitione, quam illa superiore, opus esse. Informationes enim oraculi et sensus, et re proculdubio et modo insinuandi differunt; sed tamen spiritus humanus unus

[1] so in the original. It should be *Theologica*. See the heading of the chapter, and compare *De Aug.* ii. 1. — *J. S.*

atque idem est: perinde ac si diversi liquores, atque per divisa infundibula, tamen in unum atque idem vas recipiantur. Quare et Theologiam ipsam aut ex historia sacra constare asserimus, aut ex præceptis et dogmatibus divinis, tanquam perenni quadam philosophia. Ea vero pars quæ extra hanc divisionem cadere videtur (quæ est prophetia) et ipsa historiæ species est, cum prærogativa divinitatis in qua tempora conjunguntur, ut narratio factum præcedere possit; modus[1] autem enuntiandi et vaticiniorum per visiones et dogmatum cœlestium per parabolas participat ex poësi.

CAPUT II.

Partitio Historiæ in Naturalem et Civilem; Ecclesiastica et Literaria sub Civili comprehensa. Partitio Historiæ Naturalis in Historiam Generationum, Prætergenerationum, et Artium, ex triplici statu naturæ, liberæ *videlicet,* aberrantis, *et* constrictæ.

Historia aut Naturalis est, aut Civilis. In Naturali naturæ res gestæ et facinora memorantur; in Civili, hominum. Elucent proculdubio divina in utrisque, sed magis in humanis, ut etiam propriam in historia speciem constituant, quam Sacram aut Ecclesiasticam appellare consuevimus. Itaque eam Civili attribuimus; at primo de Naturali dicemus. Naturalis Historia rerum singularium non est; non quod perperam a nobis positum sit historiam versari in individuis, quæ loco et tempore circumscribuntur. Nam proprie ita se res habet. Sed cum promiscua sit rerum naturalium similitudo, adeo ut si unum noris omnia noris, superfluum quiddam esset et infinitum de singulis dicere. Itaque sicubi absit illa

[1] *modum* in the original. — *J. S.*

promiscua similitudo, recipit etiam historia naturalis individua; ea scilicet quorum non est numerus, aut natio quædam. Nam et solis, et lunæ, et terræ, et similium, quæ unicæ sunt in specie sua, rectissime conscribitur historia; nec minus eorum quæ insigniter a specie sua deflectunt, et monstrosa sunt; quandoquidem in illis, descriptio et cognitio ipsius speciei nec sufficit nec competit. Itaque hæc duo individuorum genera historia naturalis non rejicit: ut plurimum autem (quemadmodum dictum est) in speciebus versatur. At partitionem historiæ naturalis moliemur ex vi et conditione ipsius naturæ, quæ in triplici statu posita invenitur, et tanquam regimen subit trinum. Aut enim libera est natura ac sponte fusa atque cursu consueto se explicans, cum scilicet ipsa natura per se nititur, nullatenus impedita aut subacta, ut in cœlis, animalibus, plantis, et universo naturæ apparatu; aut rursus illa a pravitatibus et insolentiis materiæ contumacis et rebellis atque ab impedimentorum violentia de statu suo plane convellitur et detruditur, ut in monstris et heteroclitis naturæ; aut denique ab arte et ministerio humano constringitur et fingitur et plane transfertur et tanquam novatur, ut in artificialibus. Etenim in artificialibus natura tanquam facta videtur, et conspicitur prorsus nova corporum facies et veluti rerum universitas altera. Itaque tractat historia naturalis aut *libertatem* naturæ, aut *errores*, aut *vincula*. Quod si cuiquam molestum sit Artes dici Naturæ Vincula, cum potius liberatores et vindices censeri debeant, quod naturam in nonnullis suæ intentionis compotem faciant, impedimentis in ordinem redactis; nos vero hujusmodi delicias et pulchra dictu nil moramur; id tantum volumus et intelligimus, naturam per artem, tanquam Proteum, in necessitate poni id agendi quod

absque arte actum non fuisset: sive illud vis vocetur et vincula, sive auxilium et perfectio. Partiemur itaque Historiam Naturalem in Historiam Generationum; Historiam Prætergenerationum; et Historiam Artium, quam etiam Mechanicam et Experimentalem appellare consuevimus. Libenter autem Historiam Artium ut historiæ naturalis speciem constituimus; quia inveteravit prorsus mos disserendi et opinio, ac si aliud quippiam esset ars a natura, ut artificialia a naturalibus segregari debeant, tanquam toto genere discrepantia: unde et illud mali, quod plerique historiæ naturalis scriptores perfunctos se putant, si historiam animalium aut plantarum aut mineralium confecerint, omissis artium mechanicarum experimentis (quæ longe maximi ad philosophiam momenti sunt); tum etiam illabitur animis hominum subtilius aliud malum; nempe ut ars censeatur solummodo ut additamentum quoddam naturæ; cujus scilicet ea sit vis, ut naturam vel inchoatam perficere vel inclinatam emendare possit, minime vero radicitus transmutare atque in imis concutere; quod plurimum rebus humanis desperationis intulit. At contra illud penitus animis hominum insidere debuerat, artificialia a naturalibus non forma aut essentia, sed efficiente tantum, differre; homini vere in naturam plane nullius rei potestatem esse, præterquam motus: ut corpora scilicet naturalia aut admoveat, aut amoveat; reliqua naturam intus per se transigere. Itaque ubi datur debita admotio corporum naturalium aut remotio, omnia potest homo atque ars; ubi non datur, nihil. Rursus autem, modo corporum fiat debita illa admotio aut remotio in ordine ad aliquem effectum, sive hoc per hominem et artem fiat sive naturaliter absque homine, parum refert; neque hoc illo fortius est: veluti si quis ex aspersione

aquæ simulachrum iridis super parietem excitet, non minus obsequente utitur natura, quam cum idem fit in aëre ex nube roscida: contra vero, cum aurum invenitur in arenulis [1] purum, æque sibi ipsi ministrat natura, ac si aurum purum per fornacem et ministerium hominis excoqueretur. Aliquando autem ministerium ex lege universi aliis animalibus deputatur: neque enim minus artificiale quiddam est mel, quod fit mediante industria apis, quam saccharum, quod hominis: atque in manna (quod similis est generis) natura seipsa contenta est. Itaque cum una atque eadem sit natura, ejus autem vis per omnia valeat, neque unquam illa a seipsa desciscat, omnino tanquam ex æquo subordinata tantum ad naturam poni debent hæc tria, Cursus naturæ; Exspatiatio naturæ; et Ars sive additus rebus Homo; ideoque in historia naturali ea omnia una et continua narrationum serie involvi par est: quod etiam Caius Plinius magna ex parte fecit; qui historiam naturalem pro dignitate complexus est, sed complexam indignissime tractavit. Atque hæc sit Naturalis Historiæ partitio prima.

CAPUT III.

Partitio Historiæ Naturalis, ex usu et fine suo; quodque finis longe nobilissimus Historiæ Naturalis sit ministratio prima ad condendam Philosophiam; et quod hujusmodi historia (quæ scilicet sit in ordine ad eum finem) desideretur.

Cæterum Historia Naturalis ut subjecto triplex (quemadmodum diximus), ita usu duplex est. Adhibetur enim aut propter cognitionem rerum ipsarum quæ historiæ mandantur, aut tanquam materia prima Philo-

[1] *renulis* in the original. — *J. S.*

sophiæ. Nobilissimus autem finis historiæ naturalis is est; ut sit inductionis veræ et legitimæ supellex atque sylva; atque satis trahat ex sensu ad instruendum intellectum. Illa enim altera, quæ aut narrationum jucunditate delectat aut experimentorum usu juvat, atque hujusmodi voluptatis aut fructus gratia quæsita est, inferioris profecto notæ est et genere ipso vilior, præ ea cujus ea est vis et qualitas, ut propria sit parasceve ad condendam philosophiam. Hæc enim demum ea est historia naturalis quæ veræ et activæ philosophiæ solida et æterna basis constituitur, quæque lumini naturæ puro et minime phantastico primam accensionem præbet; cujus quoque neglectus, et Genius non placatus, acies illas larvarum ac veluti regna umbrarum quæ in philosophiis volitare cernuntur, cum maxima et calamitosa operum sterilitate, nobis pessimo fato immisit. Affirmamus autem et plane testamur, historiam naturalem, qualis in ordine esse debeat ad istum finem, non haberi, sed desiderari, atque inter omissa poni oportere. Neque vero aciem mentis alicujus perstringant aut magna antiquorum nomina aut magna novorum volumina, ut querelam istam nostram minus justam cogitet. Satis enim scimus haberi historiam naturalem, mole amplam, varietate gratam, diligentia sæpius curiosam. Attamen si quis ex ea fabulas, et antiquitatem, atque authorum citationes et suffragationes, lites item inanes et controversias, philologiam denique et ornamenta eximat (quæ ad convivales sermones hominumque doctorum noctes potius quam ad instituendam philosophiam sunt accommodata), profecto ad nihil magni res recidat.[1] Itaque thesaurus quidam potius ad eloquentiam a nonnullis quam solida et fida rerum narratio quæri et parari

[1] So in the original. It should probably be *recidet*. — *J. S.*

videtur. Præterea, non multum ad rem faciat memo aut nosse florum iridis aut tulupæ, aut etiam concha aut canum aut accipitrum, eximias varietates. enim et hujusmodi nil aliud sunt quam naturæ lusus dam et lascivia, et prope ad individuorum naturam a dunt. Itaque habent cognitionem in rebus ipsis exq itam; informationem vero ad scientias tenuem et supervacuam. Atque hæc sunt tamen illa in quibus uralis historia vulgaris se jactat. Cum autem dege raverit historia naturalis ad aliena, et rursus luxur sit in superfluis; tamen e contra magnæ utique et sol ejusdem partes aut prorsus prætermissæ sunt, aut ne genter et leviter tractatæ. Universa vero inquisiti sua et congerie nullo modo ad eum quem diximus fi (condendæ scilicet philosophiæ) apta et qualificata eritur. Id in membris ipsius optime apparebit, at ex comparatione ejus historiæ cujus descriptiones minibus sub oculos jam proponemus, ad eam quæ betur.

CAPUT IV.

Incipit tractatus qualis esse debeat historia desidera nempe Historia Naturalis ad condendam Phil phiam. *Id ut clarius explicetur, primo subjung partitio* Historiæ Generationum. *Ejus constituu partes quinque. Prima*, cœlestium, *Secunda*, me rorum; *Tertia*, terræ et maris, *Quarta*, collegio majorum, sive elementorum aut massarum. *Qui* collegiorum minorum *sive* specierum. *Historia* virtutum primarum *rejicitur, donec explicatio pr illius partitionis* Generationum, Prætergener num, *et* Artium, *sit absoluta.*

QUANQUAM vero e fide nostra esse censemus, h ipsius historiæ quam desideramus confectionem

aliis relinquere, sed nobis ipsis desumere, propterea quod quo magis hæc res omnium industriæ patere videatur, eo major subest metus ne ab instituto nostro aberrent; ideoque eam ut tertiam Instaurationis nostræ partem designavimus; tamen ut institutum nostrum de explicationibus sive repræsentationibus omissorum perpetuo servemus, atque etiam si quid nobis humanitus acciderit, ut aliquid in tuto positum sit, sententiam nostram et consilia de hac re jam hoc loco subjungere visum est. Historiæ Generationum, sive Naturæ Solutæ, quinque partes constituimus. Eæ sunt historia Ætheris. Historia Meteororum et Regionum quas vocant Aëris. Etenim tractum sublunarem ad superficiem usque terræ et corpora in eo locata, historiæ meteororum attribuimus. Etiam cometis cujuscunque generis (utcunque se habeat rei veritas) tamen ordinis causa locum inter meteora assignamus. Tertio subit historia Terræ et Maris, quæ conjuncta globum constituunt unicum. Atque hucusque rerum natura distribuitur ex locis et locatis: reliquæ duæ partes substantias rerum distinguunt, vel massas potius. Congregantur enim corpora connaturalia ad majores et minores massas: quæ Collegia rerum majora et minora appellare consuevimus, habentque in politia mundana rationes inter se tanquam tribus et familiæ. Itaque quarto ordine ponitur historia Elementorum sive Collegiorum Majorum; quinto et ultimo historia Specierum sive Collegiorum Minorum. Elementa enim eo sensu accipi volumus, ut intelligantur non exordia rerum, sed tantum corporum connaturalium massæ majores. Majoritas autem illa accidit propter texturam materiæ facilem, simplicem, obviam et paratam; cum species a natura parce suppeditentur, propter texturam dissimilarem, atque in plurimis organicam.

Virtutum vero illarum, quæ in natura censeri possint tanquam Cardinales et Catholicæ, Densi, Rari, Levis, Gravis, Calidi, Frigidi, Consistentis, Fluidi, Similaris, Dissimilaris, Specificati, Organici, et similium, una cum motibus ad illa facientibus, uti Antitypiæ, Nexus, Coitionis, Expansionis, et reliquorum (quorum historiam omnino congeri et confici volumus, etiam priusquam ad opus intellectus deveniatur) virtutum et motuum historiam, ejusque conficiendæ modum, tum tractabimus, postquam explicationem triplicis illius partitionis, Generationum, Prætergenerationum, et Artium absolverimus. Neque enim eam scilicet intra triplicem illam nostram partionem inclusimus, cum non proprie sit historia, sed inter historiam et philosophiam veluti terminus medius. Jam vero de Historia Cœlestium, et deinceps de reliquis dicemus atque præcipiemus.

CAPUT V.

Resumitur tractanda Historia Cœlestium; *qualis et esse debeat in genere, et quod legitima hujusce historiæ ordinatio versetur in triplici genere præceptorum; videlicet, de Fine, de Materia, ac de Modo conficiendæ hujusmodi historiæ.*

Historiam Cœlestium simplicem esse volumus, nec dogmatibus imbutam; sed veluti suspensa vi et doctrina theoriarum; quæque solummodo phænomena ipsa sincera complectatur et separata, quæ jam dogmatibus fere concreverunt; denique quæ narrationes proponat eo prorsus modo, ac si nihil ex artibus astronomiæ et astrologiæ decretum esset, sed experimenta tantum et observationes exacte collecta et perspicue descripta forent. In quo genere historiæ nihil adhuc invenitur, quod nostro respondeat voto. Hujusmodi quiddam

tantummodo cursim et licenter attigit Caius Plinius: sed optima foret ea historia cœlestium, quæ ex Ptolemæo et Copernico et doctioribus[1] astronomiæ scriptoribus exprimi et erui possit, si artem experimento plane spolies, adjunctis etiam recentiorum observationibus. Quod si cui mirum videatur, nos tanto labore parta, aucta, emendata, rursus ad primam imperitiam et nudarum observationum simplicitatem retrahere velle; nos vero nulla cum priorum inventorum jactura, tamen longe majus opus movemus; neque enim calculos aut prædictiones tantum meditamur, sed philosophiam; eam scilicet, quæ de superiorum corporum non motu solummodo ejusque periodis, sed substantia quoque et omnimoda qualitate, potestate, atque influxu, intellectum humanum informare, secundum rationes naturales atque indubitatas absque traditionum superstitione et levitate possit; atque rursus in motu ipso invenire atque explicare, non quid phænomenis sit consentaneum, sed quid in natura penitus repertum atque actu et reipsa verum sit. Facile autem quis cernat, et eos quibus terram rotari placet, et eos contra qui primum mobile et veterem constructionem tenuerunt,[2] æqua fere et ancipiti phænomenorum advocatione niti. Quin et ille novæ constructionis nostra ætate author, qui solem secundi mobilis, quemadmodum terram primi mobilis, centrum constituit, ut planetæ in propriis suis conversionibus circa solem choreas ducere videantur (quod ex antiquioribus nonnulli de Venere et Mercurio suspicati sunt), si cogitata ad exitum perduxisset, belle profecto rem conficere potuisse videtur.[3] Neque vero nobis dubium est, quin et aliæ hujusmodi constructiones ingenio

[1] *doctoribus* in the original. — *J. S.*

[2] Compare *Redargutio Philosophiarum*, p. 75. note 1. — *J. S.*

[3] The reference is to Tycho Brahe, and by *nonnulli ex antiquis* Bacon probably meant Martianus, Capella, and Vitruvius.

et acri cogitatione adinveniri possint. Neque illis qui ista proponunt admodum placet, hæc quæ adducunt prorsus vera esse, sed tantummodo ad computationes et tabulas conficiendas commode supposita. At nostra ratio alio spectat; non enim concinnationes, quæ variæ esse possunt, sed veritatem rei quærimus, quæ simplex est. Ad hoc vero historia phænomenorum sincera viam aperiret,[1] infecta dogmate obstruet. Neque illud tacemus, nos in hac ipsa historia cœlestium ad normam nostram facta et congesta, spem per se ponere veritatis circa cœlestia inveniendæ; sed multo magis in observatione communium passionum et desideriorum materiæ in utroque globo. Etenim ista æthereorum et sublunarium quæ putantur divortia, commenta nobis videntur et superstitio cum temeritate; cum certissimum sit complures effectus, veluti expansionis, contractionis, impressionis, cessionis, congregationis ad massas, attractionis, abactionis, assimilationis, unionis, et similium, non solum hic apud nos, sed et in fastigiis cœli et in visceribus terræ locum habere. Atque non alii interpretes magis fidi adhiberi aut consuli possunt, ut intellectus humanus et ad profunda terræ, quæ omnino non cernuntur, et ad alta cœli, quæ plerunque fallaciter cernuntur, penetret. Itaque optime antiqui, qui Proteum illum multiformem, etiam vatem termaximum fuisse retulerunt; qui futura, præterita, et occulta præsentium novisset. Nam qui materiæ passiones catholicas novit, atque per hæc novit quid esse possit, non poterit non nosse etiam quid fuerit, quid sit, et quid futurum sit, secundum summas rerum. Itaque plurimum spei et præsidii ad contemplationem cœlestium in physicis rationibus collocamus: per physicas rationes intelligendo, non eas quæ vulgo esse putantur, sed tantum doctrinam

[1] So in the original. It should probably be *aperiet*. — *J. S.*

circa illos appetitus materiæ, quos nulla regionum aut locorum diversitas distrahere aut disterminare queat. Neque propterea (ut ad propositum revertamur) ulli diligentiæ parci volumus, quæ circa phænomenorum ipsorum cœlestium narrationes et observationes possit impendi. Nam quanto uberior suppetat apparentiarum hujusmodi copia, tanto omnia erunt et magis in promptu et firmiora. De quo antequam plura dicamus, est plane quod gratulemur et mechanicorum industriæ, et doctorum quorundam hominum curæ et alacritati, quod jam nuper per instrumentorum opticorum veluti scaphas et naviculas nova tentari cœperint cum cœlestibus phænomenis commercia. Atque hoc inceptum et fine et aggressu nobile quoddam et humano genere dignum esse existimamus: eo magis quod hujusmodi homines et ausu laudandi sint et fide; quod ingenue et perspicue proposuerunt quomodo singula illis constiterint. Superest tantum constantia cum magna judicii severitate, ut et instrumenta mutent, et testium numerum augeant, et singula et sæpe experiantur et varie, denique ut et sibi ipsi objiciant et aliis patefaciant quicquid in contrarium objici possit, et tenuissimum quemque scrupulum non spernant; ne forte illis eveniat, quod Democrito et aniculæ suæ evenit circa ficus mellitas, ut vetula esset philosopho prudentior, et magnæ et admirabilis speculationis causæ subesset error quispiam tenuis et ridiculus. At ista tanquam præfati in genere, accedamus ad descriptionem historiæ cœlestium magis explicatam; ut ostendamus quæ et qualia circa cœlestia quæri oporteat. Primo igitur quæstiones naturales, aut saltem ex iis nonnullas easque præcipuas proponemus: iis usus humanos quales verisimile est ex cœlestium contemplatione educi posse adjiciemus; hæc utraque tanquam

historiæ scopum; ut quibus historiam cœlestium componere curæ erit norint quid agatur, easque quæstiones una cum operibus illis et affectis habeant in animo et intueantur; unde talem instituant et parent historiam, qualis ad judicia hujusmodi quæstionum, et præbitionem hujusmodi fructus et utilitatum erga genus humanum, sit accommodata. Quæstiones autem intelligimus ejus generis, quæ de facto naturæ quærant, non de causis. Hoc enim pertinet proprie ad historiam. Deinde distincte monstrabimus in quibus Historia Cœlestium consistat, quæque ejus sint partes; quæ res sint apprehendendæ aut exquirendæ, quæ experimenta sint comparanda et procuranda, quæ observationes adhibendæ et pensitandæ, proponentes tanquam Topica quædam inductiva, sive Articulos ad interrogandum de cœlestibus. Postremo præcipiemus nonnulla non solum de eo quod quæri oporteat, sed et de hoc, quomodo quæsita debeant pensitari, etiam exhiberi atque in literas referri, ne primæ inquisitionis diligentia pereat in successione, aut, quod pejus est, infirmis et fallacibus initiis nitantur progressus qui sequentur. In summa, dicemus et ad quid quæri debeat circa cœlestia, et quid, et quomodo.

CAPUT VI.

Quod quæstiones philosophicæ circa cœlestia, *etiam quæ præter opinionem sunt, et quodammodo durœ, recipi debeant: proponuntur vero quinque quæstiones circa systema ipsum; videlicet,* an sit systema; *et, si sit,* quod sit centrum ejus, *et* qualis profunditas, *et* qualis connexio, *et* qualis partium collocatio.

Existimabimur autem plerisque proculdubio reliquias quæstionum veterum, jam pridem quasi tumulo

conditas et sepultas, rursus eruere, et fere manes earum evocare, iisque novas insuper quæstiones adspergere. Sed cum ea quæ adhuc habetur circa cœlestia philosophia nihil habeat firmitudinis; cumque illud nobis perpetuo ratum et fixum sit, omnia novo legitimæ inductionis judicio sistere; cumque si forte quæstiones aliquæ a tergo relinquantur, tanto minus operæ et diligentiæ consumetur in historia, propterea quod supervacuum fortasse videbitur ea inquirere de quibus quæstio non fuerit mota; necesse habemus quæstiones, quas ubique porrigit rerum natura, in manus accipere. Quin quo minus[1] certi sumus de quæstionibus per viam nostram determinandis, eo nos minus difficiles præbemus in iisdem recipiendis. Exitum enim rei videmus. Prima igitur ea quæstio est, *An sit systema?* Hoc est, An mundus sive universitas rerum sit globosa secundum totum, cujus sit centrum aliquod? An potius globi particulares terræ et astrorum spargantur; et singuli suis hæreant radicibus, absque systemate et medio sive centro communi? Atque certe jactavit schola Democriti et Epicuri, authores suos mœnia mundi diruisse.[2] Neque tamen id prorsus secutum est ex iis, quæ ab illis dicta sunt. Nam Democritus cum materiam sive semina copia infinita, attributis et potestate finita, eademque agitata, nec ab æterno quovis modo locata, posuisset, vi ipsa illius opinionis adductus est, ut mundos multiformes, ortui et interitui obnoxios, alios melius ordinatos, alios male hærentes, etiam tentamenta mundorum et intermundia statueret. Sed tamen ut hoc

[1] So in the original. — *J. S.*

[2] See Lucretius, i. 957., for the infinitude of the universe; and compare his praise of Epicurus: —

"vivida vis animi pervicit et extra
Processit longe flammantia mœnia mundi."

De Rer. Nat. i. 73.

receptum fuisset, nihil officiebat quin illa pars materiæ quæ deputata est huic ipsi mundo, qui nostro generi est conspicuus, obtinuerit figuram globosam. Necesse enim fuit ut singuli ex illis mundis figuram aliquam acciperent. Etsi enim in infinito medium aliquod esse nequeat, tamen in partibus infiniti rotunda figura subsistere potest, non minus in mundo aliquo quam in pila. Verum Democritus sector mundi bonus fuit, in integralibus autem mundi etiam infra mediocres philosophos. At opinio illa de qua nunc loquimur, quæ destruebat et confundebat systema, fuit Heraclidis Pontici, et Ecphanti, et Nicetæ Syracusani, et præcipue Philolai, atque etiam nostra ætate Gilberti, et omnium (præter Copernicum) eorum qui terram planetam et mobilem, et tanquam unum ex astris, crediderunt.[1] Atque illa opinio hanc vim habet, ut planetæ et stellæ singulæ, atque

[1] All the persons here mentioned affirmed that the earth moved, but their opinions are not accurately represented. Thus Ecphantus and Heraclides denied that the earth changes its place. According to them it moves, but οὐ μὴν γε μεταβατικῶς (*Plutarch, De Placit. Philos.* iii. 13.): and with respect to Ecphantus we are expressly told by the pseudo-Origen, *Philos.* c. 15., that he affirmed τὴν γῆν μέσον κόσμου κινεῖσθαι περὶ τὸ αὐτῆς κέντρον, ὡς πρὸς ἀνατολήν: so far was he from rejecting the notion of a κόσμος or system. Philolaus undoubtedly admitted the motion of the earth through space, and so probably did Nicetas, or rather Hicetas; but neither of them rejected the notion of a system. For Philolaus, see Boeckh's *Philolaus* and the second dissertation *De Platonico Systemate*. The Philolaic system (although Martin appears to doubt it) was probably the same as that of the Pythagoreans in general. According to it, neither the earth nor the sun are at rest, but, with the planets, revolve about a central fire, the light from which is reflected to us from the sun. It never reaches us directly, because between us and it revolves the Antichthon, which is either a separate planet, or simply the other side of the earth, for the point does not seem quite settled. The passage in the text is apparently taken from Gilbert, *De Magnete*, vi. 8. Heraclides, though he did not believe in the earth's moving through space, yet affirmed, as did also the Pythagoreans, that each of the heavenly bodies constitutes a κόσμος in itself. See Stobæus, *Ec. Phys.* i. 25. On the other hand, Philolaus and Ecphantus distinctly asserted the unity of the universe. See Stobæus, ubi supra, i. 16. and 25.

etiam aliæ innumeræ quæ conspectum nostrum ob distantiam fugiunt, necnon aliæ quæ nobis sunt invisibiles propter naturam non lucentem sed opacam, suos quæque sortitæ globos et formas primarias, per expansionem istam quam suspicimus immensam, sive vacui sive corporis cujusdam tenuis et fere adiaphori, tanquam insulæ in pelago immenso spargantur et pendeant, atque super centrum non commune aliquod, sed quæque globi sui proprii volent; aliæ simpliciter, aliæ cum motu nonnullo centri progressivo. Atque illud maxime durum est in hac opinione, quod tollunt quietem sive immobile e natura.[1] Videtur autem, quemadmodum sunt in universo corpora quæ rotant, id est, motu feruntur infinito et perpetuo, ita et ex opposito debere esse corpus aliquod quod quiescat: quibus interponitur media natura eorum quæ feruntur recta, cum motus rectus partibus globorum conveniat, et rebus exulantibus extra patrias suas, quæ ad globos connaturalitatis suæ movent, ut cum iis unitæ ipsæ quoque aut rotent aut quiescant. Verum huic quæstioni (nempe *an sit systema*) finem dabunt ea quæ circa motum terræ, *an* scilicet *terra stet aut rotet?* atque circa substantiam astrorum, *an sit solida aut flammea*, et circa æthera sive spatia cœli interstellaria, *an sint corporea aut vacua*, decerni poterunt. Nam si terra stet, et cœli motu diurno circumvolvantur, proculdubio est systema; quod si terra rotet, tamen non prorsus evincitur non esse systema, propterea quod aliud possit poni centrum systematis, videlicet sol, aut aliud quippiam. Rursus, si unicus globus terræ sit densus et solidus, videtur materia universi coire et densari ad centrum illud: quod si inveniantur luna

[1] Yet Bacon would have found, by referring to Cicero, that Nicetas at least denied that any part of the universe except the earth is in motion.

aut alii ex planetis constare etiam ex materia densa et solida. videntur ex eo coire densa non ad centrum aliquod, sed sparsim et quasi fortuito. Postremo, si ponatur vacuum congregatum in spatiis interstellaribus, videntur globi singuli habere circa se effluvia tenuiora, et deinde vacuum.[1] Quod si et illa spatia corpore replentur, videtur esse unio densorum in medio, et rejectio tenuiorum ad circumferentiam. Plurimum autem confert ad scientias, nosse conjugationes quæstionum, propterea quod in aliquibus invenitur historia sive materia inductiva ad eas dirimendas, in aliquibus non item. Dato vero systemate, proxime accedit quæstio ea secunda, *quod sit centrum systematis?* Enimvero si aliquis ex globis locum centri occupare debeat, occurrunt globi imprimis duo, qui naturam medii sive centri præferre videntur, Terra et Sol. Pro Terra suffragantur aspectus noster et inveterata opinio, atque illud omnium maxime, quod cum densa coëant in angustum, rara in latum diffundantur (area autem omnis circuli contrahatur ad centrum), videtur sequi quasi necessario, ut angustiæ circa medium mundi statuantur, ut proprius locus et tanquam unicus ad corpora densa. Pro Sole autem facit ratio illa, quod cujus partes sunt in systemate maximæ et potissimæ, ei is locus assignari debeat ex quo ipse in universum systema maxime agere et se communicare possit. Quando vero is sit sol, qui mundum vivificare plurimum videatur, impertiendo calorem et lucem; rite omnino atque ordine videri possit collocatus in medio mundi. Accedit et illud, quod sol manifeste habeat assectatores Venerem et Mercurium,[2]

[1] Compare Gilbert, Physiol. ii. 27.

[2] It is difficult to see why Bacon should speak of this as manifest; the theory that Mercury and Venus are satellites of the sun constitutes a dis-

etiam ex sententia Tychonis planetas reliquos; adeo ut plane videatur sol centri naturam sustinere posse, et vices gerere in aliquibus; eo propius abest, ut universi centrum constitui possit; quæ Copernici assertio fuit. Veruntamen in systemate Copernici multa et magna inveniuntur incommoda; nam et quod triplici motu terram oneravit,[1] incommodum magnum, et quod solem a

tinct system, often called the Egyptian. See with respect to it Martin, *Etudes*, &c., vol. ii. p. 129. According to Gassendi, Copernicus was much struck by the passage of Martianus Capella in which this system is mentioned. Apelt has remarked that the Copernican system includes two distinct elements: the first the reference of the motion of the planets to the sun as a common centre; the second the doctrine of the motion of the earth. The first was common to Copernicus with Tycho Brahe; the second was his own exclusively. Tycho's system, as Apelt well observes, is the natural transition from Ptolemy's to the Copernican, and must of necessity have been arrived at as soon as the true distances between the sun and the planets were introduced into the Ptolemaic hypothesis. Thus Tycho's system is a step backwards, although it saved the phenomena as well as that of Copernicus; but, as Apelt goes on to remark, Tycho was an observer, and Copernicus a philosopher, who sought not merely for an astronomical hypothesis, but for a new idea of the universe. Copernicus says of himself, that he had set the sun, the great light of the universe, in the midst of the temple of nature, and as on a kingly throne. No man less deserved to be spoken of as a merely calculating astronomer. Bacon's difficulty, that in the Copernican system the moon revolves about the earth, had been felt by others. Galileo, at the end of the *Sydereus Nuncius*, points out the analogy of this hypothesis with what he had discovered to be the case with respect to Jupiter and his satellites, remarking that it removed the difficulty in question.

[1] Copernicus conceived the earth's motion round the sun to be as if the earth were rigidly attached to the line which joins them. Thus the motion round the sun results from the composition of two simpler motions, namely that of the earth's centre and the change of the direction of its axis. The second of these components is eliminated from the hypothesis by supposing that the earth, besides the motion round the sun and about its own axis, has a third motion, namely a change in the direction of its axis equal and opposite to that which results from the motion round the sun. Galileo showed, by an illustrative experiment, that this kind of motion was in reality only an unnecessary complication; and Gilbert also makes the same remark. See the Saggiatore, ii. 304., and the Physiol. Nova. In Germany the same thing was remarked by Rothman; but I am not aware whether he or Gilbert was the first person to introduce the simplification, which is indeed obvious.

cœtu planetarum divulsit, cum quibus tot habet passiones communes, similiter durum; et quod tantum immobilis introduxit in naturam, ponendo solem et stellas immobiles, præsertim corpora maxime omnium lucida et radiantia; et quod lunam terræ tanquam in epicyclo adhærere voluit; et alia nonnulla quæ ille sumit, ejus sunt viri qui quidvis in natura fingere, modo calculi bene cedant, nihil putet. Quod si detur motus terræ, magis consentaneum videatur, ut tollatur omnino systema, et spargantur globi, secundum eos quos jam nominavimus, quam ut constituatur tale systema cujus sit centrum sol. Idque consensus seculorum et antiquitatis potius arripuit et approbavit. Nam opinio de motu terræ nova non est, sed ab antiquis repetita, quemadmodum diximus; at illa de sole ut sit centrum mundi et immobile, prorsus nova est (excepto uno versiculo male traducto),[1] et primo a Copernico introducta.

Nevertheless the notion of a triple motion long adhered to the Copernican hypothesis. See Paradise Lost, viii. 130. Of course the earth's axis really has a third motion which gives rise to the phenomena of precession and mutation; but this is exceedingly slow. In justice to Copernicus it should be added, that though his notion of an annual third motion was unnecessary, yet he employed it, and in a correct manner, to explain precession. Boeckh's notion that the movement of the fixed stars in the theory of Philolaus was introduced for the same purpose, does not seem to be well made out. No doubt, as the earth revolved every day round Hestia, the fixed stars might have been allowed to remain at rest; but we have a remarkable example of a similar pleonasm in the astronomical theory of Cardinal Cusanus. See the fragment of Cusanus first published by Clemens in 1843: it is given *in extenso* in Apelt on the Reformation of Astronomy, p. 23.

[1] Bacon alludes to Job, ix. 6. On this verse, "Qui commovet terram de loco suo et columnæ ejus concutiuntur," Didacus à Stunicâ, in his Commentary on Job, published in 1584, founded an argument in favour of the Copernican hypothesis, alledging that no text could be found in which the earth's motion is as distinctly denied as it is here asserted: — "Nullus dabitur scripturæ sacrosanctæ locus qui tam aperte dicat terram non moveri quam hic moveri dicit." — *Stunica on Job*, p. 41. (I quote from the edition of 1591). This argument of Stunica's seems to have attracted some attention. Galileo mentions it in his letter to the Grand Duchess Christina, which was

Sequitur tertia quæstio de profunditate systematis; non ut aliqua ejus mensura capiatur perfecta, sed ut in certo ponatur, *an cœlum stellatum sit instar unius regionis, sive ut vulgo loquuntur, orbis? an vero stellæ fixæ quas vocant, sint aliæ aliis sublimiores immensa quadam profunditate?* Neque enim ullo modo fieri potest, ut illæ sint paris altitudinis, si hoc intelligatur exacte; stellæ enim proculdubio non sunt sitæ tanquam in plano, quæ habeant dimensionem quandam tantum in superficie instar macularum aut bullarum, sed sunt illæ globi integri, magni atque profundi. Itaque cum tam disparis

written about 1615. See the new edition of his works (Florence, 1843), ii. p. 52. The passage of Stunica's Commentary in which it occurs is inserted in Salisbury's *Mathematical Collections and Translations* (1661), which contains, beside a translation of the *Dialogi dei Sistemi*, translations of certain tracts on the religious question involved in the Copernican controversy. — I am not sure, though *versiculus* is an odd expression for anything except a verse in the Bible, that M. Bouillet is not right in thinking that the reference is to what is said of Philolaus by Plutarch, *De Placit. Phil.*, which (as Apelt has remarked) Copernicus has always mistranslated, confounding the central fire, the seat of the gods, with the sun. See Apelt's Reformation of Astronomy, 1852, p. 128.

Apelt altogether agrees with Bacon as to the complete originality of Copernicus, and, apparently forgetting what is said of Aristarchus by Archimedes and others, says that the idea of the annual movement of the earth sprang out of the mind of Copernicus, as Minerva from the head of Jupiter. But yet, as Humboldt has remarked, he may have been acquainted with the doctrine of Aristarchus. See *Cosmos*, vol. ii. p. 349. Bacon was not, or he would not have said that the immobility of the sun was, "excepting one versicle," a wholly new doctrine.

A third hypothesis as to Bacon's meaning is that he refers to some passage in which the sun is spoken of as τὸ μέσον, as Boeckh has pointed out in his *Commendatio Academica altera de Platonico Systemate*, &c. The sun is sometimes called μέση on musical grounds, and sometimes spoken of as μέσον πάντων, simply because it occupies a middle place among the planets. Such a passage occurs in the *Placit. Phil.*; and it is perhaps to this that Bacon refers. Compare Martin, *Etudes sur le Timée*, vol. ii. pp. 103. and 128. I have not seen Gruppe's recent work on the Cosmical System of the Ancients. The notion that Plato was the first proposer of the Copernican system seems altogether unfounded. According to Apelt, Gruppe relies on a passage in the seventh book of the *De Legibus*.

reperiantur esse magnitudinis, omnino necesse est ut aliæ promineant vel sursum versus vel deorsum, nec fieri potest ut aut per superiora aut inferiora una conjungantur superficie. Hoc vero si fiat in partibus stellarum, temerarium plane esset asserere, etiam in corpore integro, stellas non esse alias aliis altiores; sed ut hoc verum sit, tamen asseri potest crassities quædam definita (licet insignis) ejus regionis quæ vocatur sphæra sive cœlum stellatum, quæ hujusmodi prominentias et altitudinis gradus quodammodo terminet: videmus enim ex apogæis et perigæis planetarum, singulis eorum cœlis competere crassitiem notabilem, per quæ ascendant et descendant. At quæstio ista tantum eo spectat, utrum stellæ aliæ sint super alias, tanquam planeta super planetam, et quasi in diversis orbibus. Atque hæc quæstio illi alteri quæstioni, de motu aut statu terræ, similiter affinis est. Nam si stellæ moveantur motu diurno circa terram, quandoquidem eæ universæ pari incitatione et uno veluti spiritu agantur, (cumque in planetis plane constet, prout variatur in sublimitate et humilitate situs, ita etiam variari in celeritate et tarditate motus) probabile est stellas, velocitate cursus pares, etiam in una regione ætheris locari, cujus licet crassities sive profunditas ponatur esse magna, tamen non sit tanta ut faciat ad discrimen incitationis sive celeritatis in motu; sed ut per eam regionem universam omnia putentur tanquam vinculo connaturalitatis devincta pariter rotare, vel saltem cum discrepantia tali, quæ ad aspectum nostrum propter distantiam deferri non possit. Quod si terra moveatur, stellæ vel stare poterunt, quod Copernico placuit, aut, quod longe magis verisimile est, et a Gilberto introductum, illæ poterunt singulæ rotare super centrum suum in loco suo, absque aliquo motu

centri sui, quemadmodum et ipsa terra; si modo illum motum diurnum terræ ab adscititiis illis duobus motibus, quos Copernicus superaddidit, sejungas.[1] Utrum vis autem horum si fiat, nihil prohibet, quin stellæ aliæ supra alias sint donec aspectum nostrum effugiant. Quarta proponitur quæstio *de nexu sive connexione systematis*. Atque de natura et essentia corporis vel rei quæ æther purus censetur, et astris interjacet, postea inquiremus. Nunc tantum de cohærentia systematis dicemus. Ejus rei ratio est triplex. Aut enim datur vacuum, aut contiguum, aut continuum; itaque primo quæritur, *an sit vacuum coacervatum in spatiis interstellaribus?* Id quod Gilbertus diserte posuit,[2] atque etiam antiquorum nonnulli ex iis qui globos spargi sine systemate opinati sunt innuere videntur; præsertim ii qui astrorum corpora compacta asseruere. Opinio talis est: Globos universos, tam astra quam terram, ex materia solida et densa constare: illos autem in proximo circumdari genere quodam corporum, quæ sint ipsi globo aliquatenus connaturalia, sed tamen magis imperfecta, languida, et attenuata, quæque nil aliud sint quam globorum ipsorum effluvia et emanationes; qualia sunt vapores et halitus, atque adeo aër ipse, si conferantur terræ: hæc effluvia ad distantiam circa unumquemque globum non magnam pertingere: reliquum intervallum (quod longe amplissimum est) inane esse. Cui opinioni illud fidem astruere possit, quod ex tam

[1] "Manifestum ergo est quod sydera omnia tanquam in distinctis reposita locis in ipsis conglobantur, quæ centris propriis nituntur et circa ipsa confluunt partes eorum omnes. Quod si motum habent, erit ille potius circa proprium cujusque centrum, ut terræ motus, aut centri progressione in orbem, ut Lunæ; non erit in tam numerosâ solutâ grege circularis motus." — *Gilbertus, De Magnete*, vi. 3.

[2] Gilbert, Physiol. Nova, i. 22., particularly at p. 68.

immensa distantia corpora astrorum conspiciuntur. Si enim universum illud spatium plenum esset, præsertim corporum quæ proculdubio raritate et densitate valde inæqualia sunt, tanta foret radiorum refractio, ut ad visum nostrum pertingere non possint; quam si longe maxima ejus spatii pars vacua sit, facilius sane perferri consentaneum est. Atque revera hæc quæstio magna ex parte pendebit ex quæstione quam statim adducemus de substantia stellarum, *An sit densa, vel tenuis et explicata?* Nam si substantia earum sit solida, videbitur utique natura circa globos eorumque confinia tantummodo fere occupata esse et solicita; spatia vero interjacentia deserere et tanquam prætermittere. Itaque non absimile vero fuerit, globos circa centrum spissiores, circa superficiem laxiores, in ambientibus et effluviis quasi deficientes, in vacuo tandem terminari. Contra, si natura astrorum sit tenuis et flammea, apparebit naturam Tenuis non esse solummodo Densi decrementum, sed per se potentem et primariam, non minus quam naturam solidi; eamque et in stellis ipsis et in æthere et in aëre vigere, ut vacuo illo coacervato non sit opus. Pendebit quoque ista quæstio de vacuo in spatiis interstellaribus ex quæstione illa, quæ pertinet ad principia naturæ, *An detur vacuum?* Neque tamen hoc ipsum nisi adhibita distinctione. Aliud enim est negare vacuum simpliciter, aliud negare vacuum coacervatum. Longe enim firmiores sunt eæ rationes, quæ adduci possunt ad astruendum vacuum intermistum ad laxamentum corporum, quam quæ asserunt vacuum coacervatum, sive in spatiis majoribus. Neque hoc solum vidit Hero,[1] vir ingeniosus et mechanicus, sed etiam Leucippus et Democritus, inventores opinionis de

[1] See Hero. Spiritalia, Proëm.

vacuo, quam Aristoteles argutiis quibusdam obsidere et expugnare conatur; qui duo philosophi acutissimi certe et celeberrimi, ita vacuum intermistum dant, ut vacuum coacervatum tollant. Ex sententia enim Democriti vacuum terminatur et circumscribitur, ut ultra certos fines non detur distractio sive divulsio corporum, non magis quam compulsio aut compactio.[1] Licet enim in iis quæ ex Democrito habemus hoc nunquam diserte positum sit, tamen hoc dicere videtur, cum corpora æque ac spatia infinita constituit; ea usus ratione, aliter (si spatium scilicet infinitum, corpora finita essent) corpora nunquam hæsura. Itaque propter co-infinitatem materiæ cum spatio, necessario compingitur vacuum ad terminos certos, quæ videtur ejus fuisse opinio vera et recte intellecta, ut scilicet constituatur finis quidam explicationis sive expansionis corporum per vacuum copulatum; neque vacuum detur solitarium, aut corpore non obsessum. Quod si non detur vacuum instar solutionis continuitatis in systemate, tamen cum tanta inveniatur in partibus et regionibus systematis corporum diversitas, ut sint tanquam alterius gentis et patriæ, oritur quæstio secunda quæ ad connexionem systematis pertineat; ea est, *an æther purus sit unus perpetuus sive continuus fluor, an vero constet ex pluribus contiguis?* Neque vero nostrum est de verbis argutari, sed intelligimus per contiguum, corpus quod superjacet nec miscetur: neque rursus intelligimus contignationem duram, qualem vulgus astronomorum comminiscitur, sed qualem possint recipere fluores, ac si argento vivo supernataret aqua, aquæ oleum, oleo aër. Nemini enim dubium esse potest, quin in immenso illo tractu ætheris puri sint eximiæ differentiæ quoad raritatem et densita-

[1] See Lucretius, i. 983. et seq.

tem et alia non pauca; sed utro libet dato (id est, continuo sive contiguo) hoc fieri potest. Nam satis constat, nec in mari ipso aquam in summo et aquam in imo ejusdem esse consistentiæ et saporis; in aëre vero, inter aërem terræ conterminum et aërem superiorem plurimum interest, et tamen unus et integer est et perpetuus fluor. Itaque deducitur quæstio ad hoc, *utrum differentiæ in tractu ætheris puri se insinuent gradatim et fluxu quodam continuo; an constituantur et distribuantur ad certos et notabiles limites, ubi corpora conjunguntur quæ non sint commiscibilia, quemadmodum apud nos aër incumbit aquæ.* Enimvero simplicius contemplanti videtur totum istud purum et liquidum corpus in quo globi terræ et astrorum, tanquam in vastissimo pelago, pendent et natant, quodque interjunctum illis globis quanto ipso et spatio quod occupat globorum mensuras quasi innumeris partibus superat, esse indivisa quædam res et summe unita. Verum naturam diligentius intuenti illud plane constabit, consuesse naturam ad spatia nonnulla per gradus, deinde subito per saltus procedere, atque hunc processum alternare. Aliter, si quis vere introspiciat, nulla possit constitui fabrica rerum, nulla figura organica, si per gradus insensibiles perpetuo procederetur. Itaque processus ille per gradus intermundiis competere possit, non mundo, ad cujus constructionem necesse est longe dissimilia discludi alia ab aliis, et tamen approximari. Itaque terram et aquas excipit et contingit aër, corpus longe diversum, et tamen in proximo locatum; non primo limus, deinde vapor aut nebula, dein aër purus; sed confestim aër absque medio. In aëre vero et æthere (illa enim duo conjungimus) dispertitio maxime omnium insignis et radicalis sumi posse videtur, ex

natura magis aut minus susceptiva naturæ stellaris. Itaque tres secundum genera videntur esse regiones maximæ notabiles a globo terræ ad fastigia cœli; nimirum tractus aëris, tractus cœli planetarum, et tractus cœli stellati. Atque in infimo tractu natura stellaris non consistit; in medio consistit, sed coit ad globos singulos; in supremo spargit se per globos plurimos, adeo ut per summitates ejus videatur transire quasi in empyreum integrum. Neque interim obliviscendum ejus quod paulo ante diximus, consuesse naturam processum graduatum et persultorium alternare, adeo ut regionis primæ confinia communicent cum secunda, et secundæ cum tertia. Nam et in aëre sublimiore, postquam aër cœperit esse ab effluviis terræ defæcatior et a cœlestium magis attenuatus, tentat et experitur consistere flamma; ut in cometis humilioribus fit, qui sunt mediæ cujusdam naturæ inter naturam stellarem consistentem et evanidam; et rursus videtur cœlum circa solem fortasse stellescere, et transire incipere in naturam cœli stellati. Nam possint illæ maculæ quæ in sole observatione certe fida et diligenti deprehensæ sunt, esse rudimenta quædam materiæ stellaris; at in cœlo Jovis etiam stellæ absolutæ et perfectæ conspiciuntur, licet propter parvitatem absque commoditate perspicillorum invisibiles;[1] et rursus in summitatibus cœli stellati ex innumeris micationibus ætheris inter stellas numeratas (cujus aliæ causæ satis frigidæ reddi solent) videtur natura stellaris magis fundi et continuari.[2] Verum de his in quæs-

[1] *invisiles* in the original. — *J. S.*

[2] See the *Sydereus Nuncius* of Galileo, which had just appeared when this tract was written; and compare the following passage in the letter of Sir Wm. Lower to Harriot, written when he had first heard of Galileo's discoveries. "We Traventane philosophers were a consideringe of Kepler's reasons by which he indeavers to overthrow Nolanus and Gilbert's opin-

tionibus quas nunc proponemus de substantia et astrorum et coeli interstellaris plura dicemus. Haec enim quae diximus pertinent tantum ad quaestiones de nexu systematis. Superest quinta quaestio de collocatione partium systematis, sive de ordine coelorum. Atque dato quod non sit systema, sed spargantur globi; aut dato quod sit systema, cujus sit centrum sol; aut etiamsi videant astronomi de aliquo novo systemate; tamen manet utique inquisitio, *quae planeta ad alium planetam sit magis propinquus aut remotus*; et similiter *qui planeta magis aut minus elongetur a terra aut etiam a sole*. Quod si recipiatur systema veterum, non videtur causa cur magnopere insistatur inquisitioni novae de quatuor coelis superioribus, Stellarum Fixarum scilicet, Saturni, Jovis, et Martis. Nam de eorum positura atque ordine, et seculorum consensus suffragatur, nec phaenomenon ullum adversatur; atque rationes motuum (unde sumitur de altitudinibus coelorum praecipua probatio) accommodatae sunt, et nusquam turbant. Verum de Sole, Venere, et Mercurio, et Luna etiam, secundum systema veterum dubitatum est ab antiquis:[1] atque apud

ions concerninge the immensitie of the sphaere of the starres . . . . Said I (havinge heard you say often as much what is [if?] in that huge space betweene the starres and Saturne, ther remaine ever fixed infinite numbers which by reason of their lesser magnitudes due flie our sighte . . . what if about 6, 7, 8 &c., ther move other planets also which appear not. Just as I was saying this comes your letter, which when I had redd, Loe, quod I, what I spoke probablie, experience hath made good." The name "Traventane" is taken from his house Traventi. It probably alludes to the title *Consentine philosophers*, affected by the disciples of Telesius. Bruno affected to talk of the Nolan philosophy.

[1] It was doubted whether the orbs of Venus and Mercury are superior to the sun's or inferior to it. The former was the older hypothesis and is preferred by Ptolemy; who however remarks that some had dissented from it. See the Megal. Syntaxis, iv. 1. Bacon's information is apparently derived from Patricius, *Pancosmia*, 13.

recentiores quoquè de Venere et Mercurio ambigitur, *uter planeta sit altero superior.* Nam pro Venere ut sit superior, stat illa ratio, quod tardius nonnihil movet; et pro Mercurio, quod alligatur ad distantiam propiorem a sole, unde quis asserat debere eum proxime ad solem collocari. De luna vero nemo unquam dubitavit, quin locata sit proxime ad terram, licet variatum sit de appropinquatione ejus ad solem. Neque serio contemplantem fugere debet aliud genus quæstionis, pertinens ad constitutionem systematis; hæc est, *utrum planeta alter alterum per vices supergrediatur quandoque, et quandoque rursus subeat;* id quod de Venere per demonstrationes quasdam non indiligentes evinci videtur, ut illa aliquando inveniatur super solem locata, aliquando subter. Atque omnino recte quæritur, *utrum apogæum humilioris planetæ perigæum superioris non secet, ejusque fines subintret.* Restat ultima quæstio *de collocatione partium systematis*, hoc est, *utrum sint plura et diversa centra in systemate, et plures tanquam choreæ:* cum præsertim non solum Terra primi mobilis, Sol (ex sententia Tychonis) secundi mobilis, verum etiam Jupiter minorum et nuperorum illorum erronum[1] ex Galilæo centrum constituatur. Atque hæ sunt quæstiones illæ quinque, quæ de systemate ipso proponendæ videntur, *An sit* videlicet *systema;* et *quod sit centrum ejus;* et *quanta profunditas;* et *qualis nexus ejus;* et *quis ordo in collocatione partium.*

De extimis vero cœli, et cœlo aliquo empyreo, theses aut quæstiones non conficimus. Neque enim istarum rerum est historia, aut extat phænomenon ullum. Itaque quæ de iis sciri possunt, ea per consecutionem tan-

[1] *errorum* in the original: silently corrected by M. Bouillet. — *J. S.*

tum, ac nullatenus per inductionem sciri possunt. Erit igitur talis inquisitionis et tempus congruum, et ratio et modus quidam. De coelis vero et spatiis immateriatis, religioni omnino standum et permittendum. Quæ enim a Platonicis et nuper a Patritio [1] (ut diviniores scilicet habeantur in philosophia) dicuntur, non sine superstitione manifesta et jactantia et quasi mente turbata, denique ausu nimio, fructu nullo, similia Valentini iconibus [2] et somniis; ea nos pro rebus commentitiis et levibus habemus. Nullo modo enim ferenda est Moriæ apotheosis, tanquam Divi Claudii:[3] quin pessimum est, et plane pestis et tabes intellectus, si vanis accedat veneratio.

[1] Patritius, or rather Patricius, from whom much of the latter part of the present tract is taken, was born at Cherso in 1529, and died in 1597. He wrote a treatise on philosophy — *Nova de Universis Philosophia* — [which was published in 1591]. It is an attempt, of no great value, to conciliate Plato and Aristotle. In the last book, entitled *Pancosmia*, there is some interesting information touching theories of the tides.

[2] [*aconibus* in the original.] Valentinus is the alchemist Basil Valentine. He is said to have been a Benedictine of the congregation of St. Peter's at Erfurdt, and to have lived in the beginning of the fifteenth century. But it seems that the writings which bear his name are spurious. See Sprengel. *Hist. Med.* iii. p. 267., and Morhof, *Polyhistor*, i. p. 84., who mentions that Placcius, in the *Pseudon. Catalog.*, is disposed to deny the existence of any such person, and does not believe that his name could be found either in the provincial catalogue of Benedictines at Erfurdt, or in the general one at Rome.

[3] See the *Ludus de Morte Claudii Cæsaris* of Seneca.

CAPUT VII.

Sequuntur quæstiones de substantia cœlestium; qualis, *videlicet*, sit substantia cœlestium in genere comparata ad corpora sublunaria; et qualis substantia ætheris interstellaris comparata ad corpus stellæ; *et* qualis sit substantia astrorum ipsorum comparata ad invicem, et comparata ad ignem nostrum, et in natura propria; *et* qualis sit substantia galaxiæ et macularum nigrarum in hemisphærio antarctico? *Tum proponitur quæstio prima*, An sit heterogenea inter cœlestia et sublunaria, et qualis ea esse possit?

Absolutis quæstionibus de systemate, pergendum ad quæstiones de substantia cœlestium. Nam de substantia cœlestium inquirit præcipue philosophia, et de causis motus eorum: de motu ipso vero et ejus accidentibus, astronomia: de influxu et potestate, utraque. Debuerat autem esse cautum inter astronomiam et philosophiam, ut astronomia præferat hypotheses quæ maxime expeditæ ad compendia calculorum; philosophia vero quæ proxime accedunt ad veritatem naturæ. Atque insuper, ut astronomiæ hypotheses ad commoditatem suam, rei veritati nullo modo præjudicent, vicissim ut philosophiæ decreta talia sint, quæ sint super phænomena astronomiæ omnino explicabilia. At nunc contra fit, videlicet ut astronomiæ figmenta in philosophiam invecta sint, eamque corruperint; et philosophorum speculationes circa cœlestia sibi tantum placeant, et astronomiam fere deserant, cœlestia generaliter intuentes, verum ad phænomena particularia atque eorum causas nullo modo se applicantes. Itaque cum utraque scientia (qualis nunc habetur) sit res levis et perfunctoria, fortius omnino figendus est pes; ac si ista duo, quæ propter angustas hominum contemplationes, et

usum professorium per tot secula disjungi consueverunt, una atque eadem res sint, atque in unum scientiæ corpus conflata. Itaque proponitur prima ea quæstio, *An substantia cœlestium sit heterogenea ad substantiam inferiorum?* Nam Aristotelis temeritas et cavillatio nobis cœlum peperit phantasticum, ex quinta essentia, experte mutationis, experte etiam caloris.[1] Atque misso in præsenti sermone de quatuor elementis, quæ quinta essentia illa supponit; erat certe magnæ cujusdam fiduciæ, cognationem inter elementaria, quæ vocant, et cœlestia prorsus dirimere, cum duo ex elementis, aër videlicet et ignis, cum stellis et æthere tam bene conveniant; nisi quod moris erat illi viro ingenio abuti, et sibi ipsi negotium facessere, et obscuriora malle. Neque tamen dubium est, quin regiones sub luna positæ et supra, una cum corporibus quæ sub iisdem spatiis continentur, multis et magnis rebus differant. Neque rursus hoc certius est quam illud, corporibus utriusque regionis inesse complures communes inclinationes, passiones, et motus, ut, salva naturæ unitate, ista distinguere potius debeamus quam discerpere. Quod vero attinet ad illam heterogeniæ partem, ut cœlestia ponantur æterna, inferiora corruptibilia;[2] videtur sententia illa sub utraque parte fallere, quod nec cœlo ea competat æternitas quam fingunt, neque terræ ea mutabilitas. Siquidem de terra vere rem reputanti judicium minime faciendum ex illis

[1] Aristotle affirmed that the light and heat referred to the heavenly bodies arises from the mechanical action on the air due to their motion. — *De Cœlo*, ii. 7.

"Quintessentia accipitur a Peripateticis pro Cœlo, quia iis Cœlum neque est calidum neque frigidum neque humidum neque siccum, seu pro essentia sincera et pura ut natura ætheria. Alias, cœlestis substantia, sic dicta quia est aliquid præter elementa nec in crasi horum ortum." — *Goelin, Lex. Phil.* in voce *Essentia*.

[2] Aristot. ubi suprà.

quæ nobis sunt conspicua, cum nihil ex corporibus quæ oculus humanus videt erutum sit aut ejectum ex magis profundo quam spatio fortasse trium milliarium ad plurimum; quod res nihili est, collatum ad ambitum globi terrestris universi. Itaque nihil obstat quin intima terræ pari prædita sint æternitate ac ipsum cœlum. Enimvero si terra pateretur mutationes in profundo, fieri non potest quin consequentiæ earum mutationum, etiam in nostra regione quam calcamus, majores casus parituræ fuissent quam fieri videmus. Etenim earum quæ nobis se dant conspiciendas mutationum hic versus superficiem terræ, fere se ostendit quasi semper simul causa aliqua manifesta desuper imposita, ex tempestatibus cœli, per imbres, fervores, et similia; ut terra ipsa ex se et vi propria nulli admodum mutationi causam præbere videatur. Quod si concedatur (quod certe verisimile est) etiam terram ipsam, non solum cœlestia, in regiones aëris agere, aut frigora exspirando, aut ventos emittendo, aut hujusmodi alia; tamen et ista omnis varietas referri potest ad regiones terræ ex propinquo, in quibus plurimas evenire mutationes et vices nemo sanus negaverit. Verum fatendum omnino est, ex phænomenis terræ longe maxime penetrare in profundum terræ motus, et, quæ ejus sunt generis, eruptiones aquarum, eructationes ignium, hiatus et abruptiones terrarum, et similia; quæ tamen ipsa videntur non insurgere ex longinquo, cum plurima ipsorum parvum aliquod spatium in superficie terræ occupare soleant. Quanto enim latius spatium in facie terræ occupat terræ motus, sive aliud quippiam hujusmodi, tanto magis radices et origines ejus ad viscera terræ penetrare putandum est; et quanto angustius, minus. Quod si quis asserat,[1] fieri quandoque

[1] *afferat* in the original; which has in this part many misprints. — *J. S.*

terræ motus qui amplos et spatiosos regionum tractus quatiant, prorsus ita est. At illi certe raro eveniunt, suntque ex casibus majoribus. Itaque æquiparari possunt cometis sublimioribus, qui et ipsi infrequentes sunt. Neque enim id agitur, ut terræ simpliciter asseratur æternitas, sed ut illud appareat (quod initio diximus) inter cœlum et terram, quatenus ad constantiam et mutationem, non multum interesse.[1] Neque operæ pretium est argutari de æternitate ex rationibus motus: quemadmodum enim motus circularis terminis non indiget, ita nec quies; atque æque susceptivum est æternitatis, ut densa in loco et congregatione magna connaturalitatis suæ consistant, quam ut tenuia rotent: cum partes avulsæ amborum ferantur recta. Etiam illud in argumentum sumi potest, quod terræ interiora corruptioni magis obnoxia non sint quam ipsum cœlum; quod ibi aliquid deperire solet, ubi aliquid refici potest. Cum vero imbres, et quæ de alto decidunt, quæ faciem superiorem terræ renovant, nullo modo penetrare possint ad interiora terræ, quæ tamen ipsa stant mole sua, et quanto suo; necessario fieri ut nihil deperdatur, quando nihil adsit quod succedat. Postremo, mutabilitas quæ in extimis terræ deprehenditur, videtur et ipsa per accidens esse. Nam incrustatio illa parva, quæ ad milliaria pauca deorsum extendi videtur (intra quos terminos præclaræ illæ officinæ et fabricæ, plantarum nempe et mineralium, concluduntur) nullam fere reciperent varietatem, multo minus tam pulchra et elaborata artificia, nisi ea pars terræ a cœlestibus pateretur et perpetuo vellicaretur. Quod si quis existimet calorem et vim activam solis et cœlestium universæ terræ crassitu-

[1] ...are Telesius, *De Rerum Nat.* i. 11.: "Sol modo terraque . . . nec ea nec immutari videntur."

dinem transverberare posse, is superstitiosus et fanaticus censeri possit; cum liquido pateat quam parvo objectu ea retundi et cohiberi possint. Atque de constantia terræ hactenus: videndum jam de mutabilitate cœlestium.

Primo igitur non ea utendum est ratione, mutationes in cœlo non fieri, quia sub aspectum nostrum non veniunt. Aspectum enim frustrat et loci distantia, et lucis sive excessus sive defectus, et corporis subtilitas aut parvitas; neque enim scilicet si oculus in circulo lunæ positus esset, hic quæ apud nos in superficie terræ fiunt mutationes, veluti inundationes, terræ motus, ædificia, structuras aut moles, cernere posset; quæ parvæ festucæ rationem non exæquant ad tantam distantiam. Neque ex eo, quod cœlum interstellare diaphanum sit, et stellæ noctibus serenis eædem numero et facie cernuntur, quis facile pronunciet universum corpus ætheris limpidum, purum, et immutabile esse. Nam et aër innumeras varietates suscipit, æstus, frigoris, odorum, et omnigenæ misturæ cum vaporibus subtilioribus, neque propterea exuit diaphanum; similiter nec imagini aut faciei illi cœli credendum. Nam si magnæ illæ nubium moles quæ cœlum interdum involvunt, et solis et astrorum conspectum tollunt a nobis propter propinquitatem ipsarum ad visum nostrum, in superioribus cœli partibus penderent, neutiquam illæ faciem cœli sereni mutarent: nam nec ipsæ cerni possent propter distantiam, nec ullam eclipsin facere in astris, propter corporum parvitatem respectu magnitudinis astrorum. Quin et corpus ipsum lunæ, nisi qua parte lumen excipit, faciem cœli non mutat; ut, si lumen illud abesset, tantum corpus nos latere plane posset. At contra liquido patet ex massis corporum quæ mole et magnitudine spatiorum

distantiam vincere, et propter materiam luminosam aut splendidam visum nostrum lacessere possint, admirandas in cœlo accidere mutationes atque insolentias. Id enim perspicitur in cometis sublimioribus, iis nimirum qui et figuram stellæ induerunt absque coma, neque solum ex doctrina parallaxium [1] supra lunam collocati esse probantur, sed configurationem etiam certam et constantem cum stellis fixis habuerunt, et stationes suas servarunt, neque errones fuerunt; quales ætas nostra non semel vidit, primo in Cassiopea,[2] iterum non ita pridem in Ophiucho. Quod vero hujusmodi constantia quæ conspicitur in cometis fiat ob sequacitatem ad aliquod astrum, (quæ Aristotelis opinio fuit, qui similem rationem esse posuit cometæ ad astrum unicum et galaxiæ ad astra congregata, utrumque falso), id jam olim explosum est, non sine nota ingenii Aristotelis, qui levi contemplatione hujusmodi res confingere ausus est.[3] Neque vero ista mutatio in cœlestibus circa stellas novas, locum tenet solummodo in iis stellis quæ videntur esse naturæ evanidæ, sed etiam in iis quæ morantur. Nam et in stella illa nova Hipparchi,[4] apparitionis mentio facta est apud veteres, disparitionis nequaquam.[5] Etiam conspici nuper cœpit stella nova in pectore Cygni, quæ

[1] Galileo (in the opening of his first lecture on the new star in 1604) "showed *from the absence of parallax*, that the new star could not be, as the vulgar hypothesis represented, a mere meteor engendered in our atmosphere and nearer the earth than the moon, but must be situated among the most remote heavenly bodies." — *Life of Galileo, L. U. K.* p. 16. — *J. S.*

[2] A new star was observed in Cassiopeia by Cornelius Gemma and Tycho Brahe in 1572; it disappeared in 1574. The star in Ophiuchus was observed by Kepler in 1604, and disappeared about the end of 1605. Compare with the argument in the text, Galileo, *Dialogi dei Sistemi.*

[3] See Aristot. Meteorol. i. 8.

[4] *Hippachi* in original. — *J. S.*

[5] See Pliny, ii. 24.

jam per duodecim annos integros duravit,[1] ætatem cometæ (qualis habetur) longo intervallo supergressa, nec adhuc diminuta aut adornans[2] fugam. Neque illud rursus proprium et perpetuum est, ut veteres stellæ mutationem prorsus non patiantur, sed tantum stellæ recentioris epiphaniæ, in quibus nil mirum si mutatio eveniat, cum ipsa generatio et origo ipsarum immemorialis non sit. Missa enim Arcadum fabula de prima epiphania lunæ, qua se jactant illi fuisse antiquiores,[3] non desunt exempla in rerum memoria satis fida, cum sol per tres vices, absque incidentia eclipsis aut interpositione nubium, aëre liquido et sereno, prodiit vultu mutato per multos dies, neque tamen similiter affectus, semel luce exili, bis subfusca. Talia enim evenerunt anno DCCXC, per septendecim dies, et temporibus Justiniani per annum dimidium,[4] et post mortem Julii Cæsaris per complures dies. Atque Julianæ illius

[1] This star, which is of variable magnitude, was first observed by Jansen in 1600, so that the *Descriptio Globi Intellectualis* must have been written in 1612.

[2] So in original. — *J. S.*

[3] Orta prior Lunâ (de se si creditur ipsi)
A magno tellus Arcade nomen habet. OVID, *Fasti*, i. 469.

See for a dissertation on this mythical story, Heyne, *Opusc.* ii. 332., and a communication from Professor Franz given in the fourth volume of Humboldt's *Cosmos*.

[4] These phenomena are mentioned in juxtaposition by Patricius, *Pancosmia*, p. 111., from whom Bacon probably derived his knowledge of them. For the darkness in 790 Patricius quotes Paul the Deacon, and for that in Justinian's time Peter Messias or Mexia, who was almost a contemporary of his own. The original authority for it is Procopius, *Bell. Vandal.* ii. 14. It is to this darkening of the sun that Bacon refers in the phrase "semel luce exili." Compare a list of seventeen examples of obscuration of the sun's light in the third volume of Humboldt's *Cosmos*. He does not mention that which took place in 790; and the obscuration in the time of Justinian is said on the authority of Abul-Faragius to have lasted 14 months. Humboldt compares it to that which took place in 1783.

obtenebrationis manet testimonium illud insigne Virgilii:

> Ille etiam extincto miseratus Cæsare Romam,
> Cum caput obscura nitidum ferrugine texit,
> Impiaque æternam timuerunt secula noctem.[1]

Varronis vero, hominis in antiquitate peritissimi, narratio quæ invenitur apud Augustinum[2] de stella Veneris, — illam scilicet tempore Ogygis regis mutavisse colorem, magnitudinem, et figuram, — dubiæ fidei esse potuit, ni simile eventum celebri spectaculo ætate nostra MDLXXVIII recurrisset. Nam tum quoque per annum integrum novatio facta est memorabilis in stella Veneris, quæ conspiciebatur magnitudine et splendore insolitis, rubedine Martem ipsum superabat, et figuram sæpius mutabat, facta quandoque triangularis, quandoque quadrangularis, etiam rotunda, ut in ipsa massa et substantia prorsus pati videretur.[3] Quin etiam stella

[1] Virg. Georg. i. 469. See Pliny, ii. 30., and the other authorities mentioned in Heyne's Virgil ad loc.

[2] St. August. De Civit. Dei, xxi. 8.

[3] Patricius was Bacon's authority for this story. After mentioning what Augustine repeats from Varro, he goes on thus: "Quæ res ævo etiam nostro accidit anno M. D LXX. VIII. Romæque visum id est die XVI Novembris. In Germaniâ vero die Decembris XXVI. Perque totum eum annum, sub vesperam, sole nondum merso visa est magnitudine insolitâ, figurâ vero modo triangulâ, modo quadrangulâ, modo rotundâ, et splendore maximo, et rubedine majore quam sit Martis rubedo. Cursum tamen non mutavit." — *Patricius, Pancosmia*, p. 107. This is given as evidence against the Aristotelian doctrine of the immutability of the heavens; and that it is not mentioned by Galileo and the other writers who so constantly refer to the new stars in Cassiopeia and Serpentarius for similar evidence seems to show that the story has no other foundation than that Venus was then visible before sunset. The story would, if true, have been a better proof of a change in the superlunary heavens than the new stars, seeing that it could not be said that Venus was a merely sublunary meteor. So wonderful a fact ought not to have been quoted on the authority of a loose and somewhat rhetorical writer like Patricius. [We must not forget however that this is an unfinished work, not published, nor prepared, nor perhaps intended, for publication by the writer. — *J. S.*]

It is possible that Patricius's story may be connected with the phenomenon

illa ex veteribus quæ in coxa Caniculæ sita est, quam ipse se vidisse dicit Aristoteles comæ nonnihil habentem eamque comam, præsertim obiter intuenti, vibrantem, mutata jam videtur et comam deposuisse, cum nihil ejusmodi jam nostra ætate deprehendatur.[1] Adde etiam quod complures mutationes cœlestium, præsertim in stellis minoribus, ex neglectu observationum facile præterlabuntur, et nobis pereunt. At promptum erit sciolo alicui ista ad vapores et dispositionem medii referre: sed mutationes quæ corpus astri alicujus constanter et æquabiliter et diu obsidere deprehenduntur et una cum astro circumvolvi, omnino in astro ipso, aut saltem in æthere propinquo statui debent, non in regionibus aëris inferioribus; cujus rei etiam argumentum sumitur plane validum, quod hujusmodi mutationes raro fiunt, et longis intervallis annorum; quæ autem in aëre fiunt per interpositionem vaporum, frequentius. Quod si quis judicium faciat ex ordine cœli atque motus ipsius æquabilitate, cœlum immutabile esse; atque certitudinem illam periodorum et restitutionum sumat in æternitatis tesseram non dubiam, cum substantiæ corruptibili vix competere videatur motus constantia; is paulo attentius dispicere debuerat, istam reditionem rerum per vices et tanquam in orbem per tempora certa, etiam hic infra apud nos reperiri in nonnullis; maxime in æstu

observed in China in 1578, and which is thus mentioned in Biot's extracts from the annals of the Ming dynasty. "1578. 22 Fevrier (période Wanli 6me année 1me lune jour Woutchin) il parut une étoile grande comme le soleil."

Humboldt observes that it is extraordinary that no mention was made in the 16th century by European astronomers of this phenomenon. It seems that Bacon has mistaken Patricius's expression "totum eum annum;" which appears to mean, not that the phenomenon lasted a year, but that it was visible to the end of the year in which it appeared. See *Connaissances des Temps* for 1846.

[1] Aristot. Meteorol. i. 6.

oceani: differentiæ autem minores quæ in cœlestibus esse possunt, et periodis et restitutionibus suis aspectum nostrum et computationes nostras fugiunt. Neque magis motus ille circularis cœli in argumentum æternitatis sumi potest; quod scilicet lationis circularis non sit terminus;[1] motus autem immortalis substantiæ immortali convenit. Nam etiam cometæ inferiores subter lunam locati rotant, idque ex vi propria; nisi quis forte credere malit commentum illud de alligatione ad astrum. Enimvero si placeat argumentari de æternitate cœlestium ex motu circulari, id ad universitatem cœli trahi debuit, non ad partes cœli; etenim aër, mare, terra, massis æterna, partibus caduca. Quin potius contra, non ita bene ominari licet de æternitate cœli ex motu illo rotationis; quia ille ipse motus non est perfectus in cœlo, nec restituit se exacte in circulo integro et puro, sed cum declinationibus, sinuationibus, et spiris. Porro si quis illud quod diximus de terra retorqueat (videlicet quod mutationes quæ in ea fiunt per accidens fieri disseruimus, eo quod terra patiatur a cœlo), atque asserat contrariam esse rationem cœli, cum cœlum nullo modo pati possit vicissim a terra, quandoquidem omnis emissio a terra citra cœlum desinat, ut probabile sit cœlum, ultra omnem vim inimicam sepositum, susceptivum esse æternitatis, cum a natura opposita minime concutiatur aut labefactetur; is non contemnenda quædam objicit. Neque enim ii sumus, qui Thaletis simplicitatem revereamur, qui ignes cœlestes depascere vapores e terra et oceano sublimatos, atque inde ali et refici opinatus est;[2] (illi vero vapores recidunt fere simili quanto ac adscenderunt, neque reficiendis et

[1] Arist. De Cœlo, i. 9.

[2] Plutarch, De Placit. Philosoph. i. 3.

terræ et globis cœlestibus ullo modo sufficiunt, neque prorsus in tam altum pervenire possint); sed tamen utcunque terræ effluvia materiata longe infra cœlum se sistant, nihilominus si terra sit primum frigidum ex sententia Parmenidis et Telesii, non facile quis affirmet aut certo ad quam altitudinem vis illa adversatrix et rivalis cœli se insinuet seriatim et per successionem, præsertim cum tenuia naturam et impressionem frigidi et calidi imbibant et longe perferant. Sed tamen, dato quod cœlum non patiatur a terra, nil obstat quin cœlestia a se invicem pati possint et immutari, sol nimirum a stellis, stellæ a sole, planetæ ab utrisque, universæ ab æthere circumfuso, præsertim in desinentiis globorum. Præterea videtur opinio de æternitate cœli magnas vires sumpsisse ex ipsa machina et constructione cœli, quam astronomi plurima cum satagentia introduxerunt. Cautum enim magnopere videtur ex ea ut cœlestia nil patiantur præter simplicem rotationem, in cæteris consistant nec perturbentur. Itaque corpora astrorum in orbibus suis tanquam clavis fixa posuerunt. Singulis autem declinationibus, sublationibus, depressionibus, sinuationibus ipsorum tot circulos perfectos convenientis crassitudinis attribuerunt, circulorum eorum et concava et convexa egregie tornantes et polientes, ut in eis nil eminens, nil asperum inveniatur, sed alter inter alterum receptus et ob lævorem exacte contiguus et tamen labi facilis, moveat placide et feliciter; quæ immortalis scilicet ingeniatio summovet omnem violentiam in perturbationem, individuas profecto corruptionis prænuntias. Nam certe si corpora tanta qualia sunt globi astrorum, æthera secant; neque tamen perpetuo meant per easdem ætheris partes, sed per partes et tractus longe diversos, cum aliquando superna invadant, aliquando

versus terram descendant, aliquando vertant se ad austrum, aliquando ad boream; periculum est proculdubio ne fiant plurimæ in cœlo impressiones et concussiones et reciprocationes et fluctus, atque inde sequantur condensationes et rarefactiones corporum, quæ generationibus et alterationibus viam præstinent et præstruant. Quandoquidem vero ex rationibus physicis, atque insuper ex phænomenis ipsis, plane constabit hoc posterius verum esse, atque commenta illa priora astronomorum de quibus diximus (si quis sanam mentem sumat) naturæ prorsus illudere videantur, et rerum reperiantur inania; consentaneum est, ut etiam opinio de æternitate cœlestium, quæ cum illis conjuncta est, idem subeat judicium. Quod si quis hic religionem opponat, illi responsum volumus, ethnicam jactantiam tantummodo istam æternitatem cœlo soli attribuere, Scripturas Sacras æternitatem terræ et cœlo ex æquo.[1] Neque enim legitur solum, *Solem et Lunam æternos et fideles testes in cœlo esse;*[2] sed et illud, *generationes advenire et migrare, Terram autem in æternum manere.* De natura autem labili et caduca utriusque, uno simul oraculo conclusum est: *Cœlum et Terram pertransire; verbum autem Domini non pertransire.*[3] Deinde si quis adhuc instet, negari tamen non posse

[1] Lansberg makes a curious remark as to the difficulties which may arise from a literal interpretation of Scripture. "You may so interpret it," he says, "as to make it interfere not only with astronomy but with geometry; as when it is said that one of the ewers in the Temple was ten cubits across and thirty cubits round." Campanella, in his *Apologia pro Galilæo*, tells a story of one Ulysses Albergettus, who wishing to show that the moon shines by her own light, quoted the text 'Luna non dabit lumen *suum*' — "faciens vim in ly suum." — *Ly*, it may be well to remark, is used by the schoolmen as τὸ in Greek; probably because transcribers were often ignorant of Greek, and copying by eye changed the form of what they did not understand.

manere," Ecclesiastes, i. 4.

[3] Matth. xxiv. 35.

quin in ipsa superficie orbis terrarum et partibus proximis infinitæ fiant mutationes, in cœlo non item; huic ita occurrimus; nec nos hæc per omnia æquare, et tamen si regiones (quas vocant) superiorem et mediam aëris pro superficie aut interiore tunica cœli accipiamus, quemadmodum spatium istud apud nos, quo animalia, plantæ, et mineralia continentur, pro superficie vel exteriore tunica terræ accipimus; et ibi quoque varias et multiformes generationes inveniri. Itaque tumultus fere omnis et conflictus et perturbatio in confiniis tantum cœli et terræ locum habere videtur; ut in rebus civilibus fit, in quibus illud frequenter usu venit, ut duorum regnorum fines continuis incursionibus et violentiis infestentur, dum interiores utriusque regni provinciæ diutina pace fruuntur, et bellis tantum gravioribus et rarioribus commoventur. Quod vero ad illam alteram partem heterogeneæ cœlestium attinet (prout asseritur ab Aristotele), quod calida non sint,[1] ne forte sequatur conflagratio Heracliti, sed quod calefaciant per accidens, conterendo et diverberando aërem; nescimus quid sibi velit hujusmodi desertor experientiæ, idque contra consensum veterum. Sed in illo minime novum est, ut unum aliquid ab experientia abripiat, et statim naturæ insultet, pusillanimus simul et audax. Verum de hoc mox dicemus in quæstione, *utrum astra sint veri ignes?* fusius vero et accuratius in consiliis nostris circa Historiam Virtutum, ubi origines et cunabula Calidi et Frigidi tractabimus, mortalibus adhuc incognita et intacta. Atque quæstio de heterogenea cœlestium ad hunc modum proposita sit. Damnare enim sententiam Aristotelis absque comperendi-

[1] They are the cause of heat by their motion and the consequent friction of the air, but are not themselves hot. Aristot. de Cœlo, ii. 7.

natione res fortasse postulat, sed nostrum non patitur institutum.

Altera proponitur quæstio, *Quale sit contentum spatiorum interstellarium?* Illa enim aut vacua sunt, quod Gilbertus sensit; aut repleta corpore quod sit ad astra instar aëris ad flammam, quod familiariter accedit ad sensum; vel repleta corpore homogeneo cum ipsis astris, lucido et quodammodo empyreo, sed secundum minus, lucis scilicet non tam præfulgidæ et vibrantis: id quod sibi velle videtur recepta opinio, quod stella sit pars densior sphæræ suæ.[1] Nihil autem officit quo minus lucidum sit diaphanum ad transmittendam lucem magis fortem. Nam acute notavit Telesius etiam aërem communem continere aliquid in se lucis, eo usus argumento, quod sint quædam animalia, quæ noctu vident, quorum scilicet visus ad tenuem hujusmodi lucem recipiendam et fovendam sit proportionatus.[2] Nam actum lucis absque ulla luce, vel ex ipsa spiritus visivi luce interna fieri, minus credibile esse. Sed et flamma ipsa diaphana conspicitur, etiam ad transmittendam speciem corporis opaci, ut in filis lucernarum patet; multo magis ad transmittendam speciem lucis intensioris. Etiam ex flammis aliæ aliis sunt pellucidiores. Idque accidit vel ex natura corporis inflammati, vel ex copia. Nam flamma sevi aut ceræ magis luminosa est, et (si ita loqui licet) magis ignea; at flamma spiritus vini magis opaca, et tanquam aërea, præsertim si in parva sit quantitate, ut flamma seipsam non inspisset. At nos hujus rei etiam experimentum fecimus; videlicet accipientes candelam ceream, eamque in situla erigentes (situla idcirco usi metallica, ut corpus candelæ a flamma quæ circumfundenda erat posset muniri), situlam vero in patera

[1] Aristot. de Cœlo, ii. 7.

[2] Telesius, De Rer. Nat. i. 3.

ubi erat parum spiritus vini collocantes, tumque primo candelam, deinde spiritum vini accendentes; ubi facile erat cernere flammam candelæ coruscantem et candidam, per medium flammæ spiritus vini infirmæ et vergentis ad diaphanum.[1] Atque pari ratione cernuntur sæpius per cœlum trabes lucidæ lucem manifestam ex se præbentes, et tenebras noctis insigniter illustrantes; per quarum corpora tamen datur conspicere astra. Attamen ista inæqualitas stellæ et ætheris interstellaris non bene definitur per tenue et densum, ut stella scilicet sit densior, æther tenuior. Nam generaliter hic apud nos flamma aëre est corpus subtilius, magis, inquam, expansum, et minus habens materiæ pro spatio quod occupat; quod etiam in cœlestibus obtinere probabile est. Durior vero est error, si stellam sphæræ partem esse intelligant veluti clavo fixam, et æthera stellæ deferens.[2] Hoc enim fictitium quiddam est, quemadmodum et orbium contiguatio illa quæ describitur. Nam corpus stellæ in cursu suo aut æthera secat, aut et æther ipse rotat simul æqualiter. Si enim inæqualiter rotet, etiam stellam secare æthera necesse est. Fabrica autem illa orbium contiguorum, ut concavum exterioris orbis recipiat convexum interioris, et tamen propter lævorem utriusque alter alterum in conversionibus suis, licet inæqualibus, non impediat,

[1] Compare *Sylva Sylvarum* (31.).

[2] The phrase fixed stars, Sidera infixa cœlo, was originally connected with the notion of the stars being fastened to the vault of heaven. The substitution, as Humboldt has remarked, of *fixa* for *infixa* or *affixa*, indicates the transition to our notion of fixed stars, which relates only to their relative immobility. See *Cosmos*, vol. iii., chapter on Fixed Stars. There is a curious passage in Acosta's History of the Indies on this subject. He conceives that both the Milky Way and what are commonly called the Coal Bags belong to the substance of the heaven itself, and prove by their motion that the heavens turn as well as the stars [i. 2.].

realis non est; cum perpetuum et continuum sit corpus ætheris, quemadmodum et aëris; et tamen quia magna reperiatur in utroque corpore diversitas, quatenus ad raritatem et alia, regiones ipsorum docendi gratia rectissime distinguantur. Itaque recipiatur sexta[1] quæstio secundum hanc nostram explicationem. Sequitur quæstio altera nec ea simplex; de substantia ipsorum astrorum. Primo enim quæritur, *An sint alii globi sive massæ ex materia solida et compacta, præter ipsam terram?* Sana enim mente proponitur ea contemplatio in libro de facie in orbe lunæ, non esse verisimile, in dispersione materiæ naturam quicquid compacti corporis erat in unicum terræ globum conclusisse, cum tantus sit exercitus globorum ex materia rara et explicata.[2] Huic vero cogitationi tam immoderate indulsit Gilbertus (in quo tamen habuit præcursores vel duces potius nonnullos ex antiquis), ut non solum terram et lunam, sed complures alios globos, solidos et opacos, per expansionem cœli inter globos lucentes sparsos asserat.[3] Neque opinio ejus hic stetit, sed et

[1] This is apparently a wrong reading for *ista*. The phrase "ista quæstio recipiatur" occurs with variations several times in the course of the tract. That the text is wrong appears not only from the circumstance that the question Bacon is speaking of is the seventh and not the sixth, but from this also, that he clearly does not intend to say "Let a sixth question be admitted," but "Let the question of which I have been speaking be admitted;" a reference which requires the demonstrative pronoun.

[2] Plutarch, De Facie in Orbe Lunæ, p. 924.

[3] "Duo sunt globorum genera, lucentia et non lucentia; lucentia Sol, fixæ splendidiores; non lucentia, ut tellus, Luna, stellæ nebulosæ." — *Gilbert, Physiol. Nov.* ii. 10.

Thales is said to have been the first person who asserted that the moon is illuminated by the sun. Ocellus, and perhaps Heraclides, said that she consists of earth surrounded by a mist. Diogenes Apolloniates, probably following Anaxagoras, affirmed that along with the visible stars revolve in the heavens ἀφανεῖς λίθοι, which occasionally fall to the earth. Stobæus, Eclog. Phys. i. 25.

globos illos lucentes ad aspectum, nimirum solem et clarissima quæque astra, ex materia quapiam solida, licet magis splendida et æquali, constitui existimavit; lucem primitivam cum lumine, quod ejus censetur imago, confundens (nam et nostrum mare ex sese lucem ad distans proportionatum ejaculari censuit); nullam autem conglobationem agnovit Gilbertus, nisi in materia solida, cujus corpora illa circumfusa rara et tenuia, effluvia quædam tantum essent et tanquam defectiones; et deinde vacuum. Verum diligentissimi cujusque et maxime sobrii investigatoris naturæ animum perstringere posset cogitatio illa de Luna, quod sit ex materia solida. Nam et lucem reverberat, nec lucem transmittit, et propriæ lucis tanquam expers est, et plena est inæqualitatis; quæ omnia solidorum sunt. Videmus enim æthera ipsum et aërem, quæ tenuia sunt corpora, solis lucem excipere, sed minime reflectere; quod luna facit. Solis vero radiorum is est vigor, ut densas admodum nubes, quæ materiæ sunt aqueæ, trajicere et penetrare possit; lunam tamen neutiquam. At lux lunæ ipsius in eclipsibus aliquibus cernitur nonnulla, licet obscura; in noviluniis autem et ætatibus lunæ, nulla, præter partem irradiatam a sole. Porro, flammæ impuræ et fæculentæ (ex quo genere substantiæ Empedocles constare lunam opinatus est[1]) sunt certe inæquales, sed tamen eæ inæqualitates non locantur, sed mobiles plerunque sunt; cum maculæ in luna constantes putentur. Accedit quoque quod maculæ illæ etiam suas subinæqualitates habere deprehendantur

[1] Empedocles said that the moon was *ἀέρα συνεστραμμένον νεφοειδῆ, πεπηγότα ὑπὸ πυρὸς ὥστε σύμμικτον, δισκοειδῆ δὲ τῷ σχήματι.* — *Stobæus, Eclog. Physic.* i. 27.

Heeren remarks that Stobæus is the only author by whom this opinion is mentioned.

per specilla optica, ut jam plane multipliciter figurata reperiatur luna, et selenographia illa sive typus lunæ, quem animo agitabat Gilbertus,[1] jam ex Galilæi et aliorum industria præsto esse videatur. Quod si luna ex materia quapiam solida constitui possit ut terræ affinis, aut fæx cœli (hujusmodi quædam jactantur), videndum rursus an illa sit in hoc genere sola. Nam et Mercurius quandoque repertus est in conjunctione solis, tanquam macula quædam, sive pusilla eclipsis. At maculæ illæ nigricantes quæ in hemisphærio antarctico inveniuntur, suntque fixæ, non secus ac galaxia, majorem injiciunt dubitationem de globis opacis etiam in partibus cœli sublimioribus.[2] Nam quod illud in causa sit, quia cœlum in illis locis sit tenue et tanquam perforatum, id minus verisimile est; propterea quod hujusmodi decrementum et tanquam privatio rei visibilis ex tanta distantia visum nostrum nullo modo percutere possit, cum etiam reliquum corpus ætheris invisibile sit, nec nisi per comparationem ad corpora stellarum cernatur. Illud fortasse magis probabile foret, nigrores illos [defectui][3] luminis imputare, quia rariores inveniuntur stellæ circa eam partem cœli, quemadmodum circa galaxiam crebriores; ut alter locus continenter luminosus videatur, alter umbrosus. Magis enim committi videntur ignes cœlestes in antarctico hemisphærio, quam in nostro; majores siquidem stellas habeat, sed pauciores, et spatia interstellaria majora. Verum ipsa traditio de maculis illis non admodum fida est, saltem non tam magna circa eam observationem adhibita est dil-

[1] See his Physiologia Nova, ii. 14., and the map of the moon by which it is illustrated.

[2] See for this Patricius, f. 90.; and Acosta's History of the Indies, book i. chap. 2.

[3] This word was supplied in Montagu's edition. —*J. S.*

igentia, ut consequentiæ inde deduci adhuc debeant. Illud magis premit inquisitionem præsentem, quod possint esse plures globi opaci per æthera sparsi, qui omnino non cernuntur. Nam et luna ipsa in primis ortibus, quatenus illustratur a sole, visum sane ferit, cornu et labro illo tenui circuli extimi, in profundo autem minime, sed cernitur eadem specie tanquam reliquus æther: et stellulæ illæ erraticæ circa Jovem a Galilæo (si fides constet) repertæ, merguntur ad visum nostrum in pelago illo ætheris, tanquam insulæ minores et non conspicuæ; similiter et illæ stellulæ quarum glomeratio effecit galaxiam, si singulæ sparsim, non congregatæ confertim, collocatæ essent, prorsus conspectum nostrum effugerent; quemadmodum et complures aliæ, quæ noctibus serenis, præsertim per hiemem, micant; etiam nebulosæ illæ stellæ sive foramina ad Præsepe,[1] jam distinctæ per specilla numerantur; quin per eadem specilla in fonte lucis omnium purissimo (solem dicimus), macularum et opaci et inæqualitatis scrupulus

[1] The nebula Præsepe in Cancer, and the one in the head of Orion, were the two first nebulæ ever resolved into distinct stars. Galileo gave figures of them as they appeared through his telescope in the *Sydereus Nuncius*. What Bacon goes on to say of spots in the sun is particularly interesting Galileo did not publish on the subject before 1613; so that Bacon's information was probably not derived from Galileo, though it is believed that Galileo's first observations were made in November 1610. The earliest account which is known to have been printed of these spots is that of Fabricius, whose father's interesting correspondence with Kepler has recently been published. His tract *De Maculis in Sole observatis* was published at Wittenberg, 1611. It seems difficult to decide the question of priority of observation between him and Galileo. Harriot observed the spots in December 1610, but did not apparently know what to make of the appearance, and does not designate the phenomena by the specific name of spots until December 1611, before which time their existence had been fully ascertained by others. He drew a picture however of what he had seen on the first occasion, of which a facsimile has been published by Professor Rigaud, to whom I am indebted for most of the substance of this note. See his Supplement to Bradley's Works, pp. 32. 35. 37.

nonnullus objectus esse videtur. Quod si nihil aliud, certe gradatio ipsa inter astra cœlestia quoad lucem, a clarissimis descendens et pertingens ad obscura et caliginosa, eo rem deducit, ut fidem faciat posse esse et globos omnino opacos. Minor enim gradus esse videtur a stella nebulosa ad opacam, quam a stella clarissima ad nebulosam. Aspectus autem noster plane fallitur et circumscribitur. Quicquid enim spargitur in cœlo, neque habet magnitudinem insignem atque etiam lucem vividam et fortem, latet, nec faciem cœli mutat. Neque vero imperiti cujusquam animum percellat, si in dubium veniat utrum globi ex materia compacta pensiles sisti possint. Nam et terra ipsa in medio aëris, rei mollissimæ, circumfusi, pensilis natat; et magnæ nubium aquosarum moles, et grandinis congeries, hærent in regionibus aëris, et inde magis dejiciuntur quam descendunt, antequam terræ vicinitatem persentiscant. Itaque optime notavit Gilbertus, corpora gravia post longam a terra distantiam motum versus inferiora paulatim exuere, utpote qui a nullo alio corporum appetitu quam illo coëundi et se congregandi ad terram (quæ est corporum cum iisdem connaturalium massa) ortum habet, atque intra orbem virtutis suæ terminatur.[1] Nam quod de motu ad terræ centrum asseritur, esset profecto virtuosum genus nihili, quod tanta ad se raperet; neque corpus nisi a corpore patitur. Itaque quæstio ista de globis opacis et solidis, licet nova et ad opiniones vulgares durior, recipiatur; atque una conjungatur quæstio illa vetus, nec tamen decisa, *quæ ex astris lucem promant primitivam, atque ex sese, et quæ rursus ex illustratione solis*, quarum altera consubstantialia videntur soli, altera lunæ. Denique omnem

[1] Gilbert, Physiol. Nova, i. 21.

inquisitionem de diversitate substantiæ astrorum ad invicem, quæ multifaria videtur, cum alia rutila, alia plumbea, alia candida, alia splendida, alia nebulosa manifesto et constanter cernantur, ad septimam quæstionem intelligimus referri. Altera quæstio ea est, *An astra sint veri ignes?* quæ tamen quæstio desiderat prudentiam quandam intelligendi. Aliud est enim dicere, *astra esse veros ignes;* aliud, *astra (sint licet veri ignes) cunctas exercere vires, atque easdem edere actiones, quas ignis communis.* Neque propterea ad ignem aliquem notionalem aut phantasticum deveniendum est, qui nomen ignis retineat, proprietates abneget. Nam et noster ignis, si in tali quanto quale est quantum astri in æthere collocaretur, differentes daturus fuerit operationes ab iis quæ reperiuntur hic apud nos; cum entia longe diversas nanciscantur virtutes, et ex quanto suo et ex consitu sive collocatione sua. Etenim massæ majores, hoc est corpora connaturalia quæ congregantur in tali quanto quod habeat analogiam ad summam universi, induunt virtutes cosmicas, quæ in portionibus suis nullatenus reperiuntur. Nam oceanus, qui est aquarum congregatio maxima, fluit et refluit; at stagna et lacus minime. Similiter universa terra pendet, portio terræ cadit. Collocatio autem entis plurimi ad omnia momenti est et in portionibus majoribus et minoribus, propter contigua et adjacentia, vel amica vel inimica. At multo majorem etiam evenire necesse est actionum diversitatem inter ignem astrorum et nostrum, quia non tantum in quanto et collocatione, sed etiam in substantia, aliquatenus varietur. Ignis enim astrorum purus, integer, et nativus; at ignis noster degener, qui tanquam Vulcanus in terram dejectus ex casu claudicat. Si quis enim advertat, habemus

ignem apud nos extra locum suum, trepidum, contrariis circumfusum, indigum, et stipem alimenti ut conservetur emendicantem, et fugientem. At in cœlo existit ignis vere locatus, ab impetu alicujus contrarii disjunctus, constans ex se et similibus conservatus, et proprias operationes libere et absque molestia peragens. Itaque nihil opus fuit Patritio, ut formam flammæ pyramidalem, qualis apud nos invenitur, salvaret, comminisci superiorem partem astri, quæ versus æthera vertitur, posse esse pyramidalem, licet inferior pars, quæ a nobis conspicitur, sit globosa.[1] Nam pyramis illa flammæ per accidens est ex coactione et constrictione aëris, siquidem flamma circa fomitem suum plenior, ab inimicitia aëris sensim constringitur et effingitur in formam pyramidis. Itaque in flamma, basis flammæ lata est, vertex acutus; in fumo, contra, inferius acutum, vertex latus, et tanquam pyramis inversa; quia aër fumum recipit, flammam comprimit. Quare consentaneum est flammam apud nos esse pyramidalem, in cœlo globosam. Similiter et flamma apud nos corpus momentaneum est, in æthere permanens et durabilis. Attamen et apud nos flamma et ipsa manere possit in forma sua et subsistere, nisi a circumfusis perderetur; quod manifestissimum est in flammis majoribus. Omnis enim portio flammæ in medio flammæ sita, et flamma undique circumdata, non perit, sed eadem numero manet inextincta, et cœlum rapide petens; at in lateribus laboratur atque abinde orditur extinctio. Cujus rei modus (flammæ interioris scilicet permanentia in figura globosa, et flammæ exterioris vanescentia et pyramis) in flammis

[1] "Astra flammæ si sunt, etsi non rotundæ sint etiamsi sursum tendant, nihil obstat quin exemplo nostrarum, procul aliquanto spectatæ, et rotundæ appareant et radiatæ." — *Patricius, Pancosmia*, xv.

bicoloribus experimento demonstrari possit. Quinetiam de ipso ardore flammæ inter cœlestem et nostram plurimum variari potest. Nam flamma cœlestis libenter et placide explicatur, tanquam in suo, at nostra tanquam in alieno compingitur et ardet et furit. Omnis etiam ignis constipatus et incarceratus fit ardentior. Enimvero et radii flammæ cœlestis postquam ad corpora densiora et magis obstinata pervenerint, et ipsi lenitatem suam deponunt, et fiunt magis adurentes. Itaque non debuit Aristoteles conflagrationem Heracliti orbi suo metuere, licet astra veros ignes statuisset. Poterit igitur ista quæstio recipi secundum hanc explicationem. Sequitur altera quæstio, *An astra alantur*, atque etiam *an augeantur*, *minuantur*, *generentur*, *extinguantur?* Atque certe ex veteribus aliquis observatione quadam plebeia ali astra putavit, instar ignis, atque aquas et oceanum et humiditatem terræ depascere atque ex vaporibus et halitibus reparari. Quæ certe opinio non videtur digna esse, ut quæstioni materiam subministret. Nam et vapores hujusmodi longe citra astrorum altitudines deficiunt; neque illorum tanta est copia, ut et aquis et terræ per pluvias et rores reparandis, atque insuper tot et tantis globis cœlestibus reficiendis sufficere ullo modo queant; præsertim cum manifestum sit terram et oceanum humore evidenter per multa jam secula non decrescere, ut tantundem reponi videatur, quantum exsorbetur. Neque etiam ratio alimenti astris tanquam igni nostro competit. Ubi enim aliquid deperit et decedit, ibi etiam reponitur quippiam et assimilatur.[1] Quod genus assimilationis ex Tartarismis est, et ex contrariorum aut dissimilium circum-

[1] *assimulatur* in the original; so also in the next sentences *assimulationis* and *assimulationem*. — *J. S.*

fusione ortum ducit. At in astrorum mole similari et interiore nil tale evenit, non magis quam in visceribus terræ, quæ nec ipsa aluntur, sed substantiam suam servant secundum identitatem, non secundum assimilationem. Attamen de extimis oris corporum sidereorum recte datur quæstio, *Utrum ea uno eodemque tenore maneant, aut æthera circumfusum deprædentur, atque etiam inficiant?* Quare eo sensu de alimoniis astrorum etiam quæri poterit. De augmentis vero et diminutionibus astrorum in toto suo, recte adjungitur quæstio; licet rara admodum fuerint phænomena, quæ illi dubitationi occasionem præbere possint. Primo enim exemplum nullum, neque simile aliquid inter ea quæ apud nos reperiuntur, huic quæstioni patrocinatur;[1] cum globus noster terræ et aquarum non videatur suscipere, secundum totum suum, augmentationem aut diminutionem evidentem aut insignem; sed molem suam et quantum suum servare. At stellæ apparent ad aspectum nostrum interdum majore, interdum minore corpore. Verum est; sed illa majoritas et minoritas stellæ vel ad longinquitatem et ad vicinitatem refertur, ut in apogæis et perigæis planetarum, vel ad constitutionem medii. Quæ vero fit ex constitutione medii facile dignoscitur, quod non alicui certæ stellæ, sed omnibus ex æquo apparentiam mutet, ut fit noctibus hiemalibus, gelu intensiore, quando stellæ auctæ videntur magnitudine, quia vapores et parcius surgunt et fortius exprimuntur, et universum corpus aëris nonnihil condensatur, et vergit ad aqueum sive crystallinum, quod species exhibet majores. Quod si forte fuerit aliqua particularis interpositio vaporum inter aspectum nostrum et astrum certum, quæ speciem astri ampliet (quod in sole et luna fre-

[1] *patrocinantur* in the original. — *J. S.*

quenter et manifesto fit, et in reliquis accidere potest), ea apparentia nec ipsa fallere potest, quia mutatio illa magnitudinis non durat, neque sequitur astrum nec cum corpore ejus movetur, verum astrum ab ea cito liberatur, et solitam recuperat speciem. Veruntamen quamvis ista ita se habeant, tamen cum et olim temporibus priscis atque etiam ætate nostra, celebri et magno spectaculo, magna novatio facta fuerit in stella Veneris et magnitudine et colore, atque etiam figura ; cumque mutatio quæ astrum aliquod certum perpetuo et constanter sequitur, et cum corpore ejus circumvolvi cernitur, necessario statui debeat in astro ipso, et non in medio ; cumque ex observationum neglectu multa quæ in cœlo fiunt conspicua prætereantur et nobis pereant ; istam partem quæstionis nonæ recte admitti censemus. Ejusdem generis est altera pars quæstionis, *Utrum astra per longos seculorum circuitus nascantur et dissipentur ?* nisi quod major suppetat phænomenorum ubertas quæ hanc quæstionem provocat quam illam de augmentis ; sed tamen in uno genere tantum. Nam quoad veteres stellas, omni seculorum memoria, nec alicujus earum ortus primus notatus est (exceptis iis quæ Arcades de Luna olim fabulati sunt), nec aliqua ex iis desideratur. Earum vero quæ cometæ habitæ sunt, sed forma et motu stellari, et prorsus veluti stellæ novæ,[1] et apparitiones

[1] This mode of speaking of the new stars confirms Professor Rigaud's explanation of a curious phrase in one of Sir William Lower's letters to Harriot. "His elliptical Iter planetarum, methinkes, shewes a way to the solving of the unknown walks of comets" (he is speaking of Kepler); "for as his ellipsis in the earth's motion is more a circle, and in Mars is more longe, and in some of the other planets may be longer againe, so in thos commets that appeare fixed the ellipsis may be neere a right line." The Professor remarks that he may possibly allude to phenomena like the new star of 1572. It is this letter of Sir William Lower's, the first part of which Baron Zach ascribed to the Earl of Northumberland,

vidimus, atque etiam ab antiquis accepimus, et disparitiones, dum aliis hominibus tanquam consumptæ visæ sunt, aliis tanquam assumptæ (utpote quæ ad nos devectæ tanquam in perigæis, postea ad sublimiora remearunt), aliis vero tanquam rarescentes existimatæ sunt atque in æthera solutæ. Verum universam istam quæstionem de stellis novis ad eum locum rejicimus ubi de Cometis dicemus. Superest quæstio altera, de Galaxia videlicet, *An Galaxia sit glomeratio astrorum minimorum, aut corpus continuatum, et pars ætheris, mediæ naturæ inter ætheream et sideream?* Nam opinio illa de exhalationibus jamdiu exhalavit, non sine nota ingenii Aristotelis, qui tale aliquid confingere ausus est, rei tam constanti et fixæ imponendo naturam transitoriam et variam.[1] Quin et finis etiam hujus quæstionis, prout a nobis proponitur, adesse jam videtur, si iis credimus quæ Galilæus tradidit, qui confusam illam lucis speciem in astra numerata et locata digessit. Nam quod Galaxia non tollit aspectum astrorum quæ intra ipsam inveniuntur, illud certe litem non dirimit, nec rem inclinat in alterutram partem; id tantummodo fortasse abnegat, non collocari Galaxiam inferius æthere stellato. Hoc enim si foret, atque insuper corpus illud continuatum Galaxiæ aliquam haberet profunditatem, aspectum nostrum interceptum iri consentaneum esset. Si vero pari collocetur altitudine cum stellis quæ per eam conspiciuntur, nil obstat quin stellæ spargi possint in ipsa Galaxia, non minus quam in reliquo æthere.

an error which is repeated by Apelt in his *Reformation of Astronomy*. See Rigaud's Supplement to Bradley's Works, pp. 43. 49.

The idea that the new star of 1572 moved alternately towards and from the earth in a right line, was proposed by John Dee. See Narrien's Hist. of Astronomy, p. 384.

[1] Arist. Meteor. i. 8.

Itaque et istam quæstionem recipimus. Atque hæ sex quæstiones pertinent ad substantiam cœlestium; qualis scilicet sit substantia cœli in genere, et qualis ætheris interstellaris, et qualis Galaxiæ, et qualis astrorum ipsorum, sive conferantur ad invicem, sive ad ignem nostrum, sive ad corpus proprium. At de numero, magnitudine, figura, et distantia astrorum, præter phænomena ipsa et quæstiones historicas, de quibus postea dicetur, problemata philosophica fere simplicia sunt. De numero scilicet sequitur quæstio altera. *An is sit numerus astrorum qui videtur, quique Hipparchi diligentia notatus et descriptus est, et in globi cœlestis modulum conclusus?*[1] Nam et satis frigida est ratio ea quæ redditur innumeræ illius multitudinis stellarum occultarum et tanquam invisibilium, quæ noctibus serenis præsertim per hiemem conspici solet; ut illæ apparentiæ scilicet sint non stellæ minores, sed radiationes tantum et micationes et tanquam spicula stellarum cognitarum; et nova jam censa sunt plebeculæ cœlestis capita a Galilæo, non solum in illa turma quæ Galaxiæ nomine insignitur, verum etiam inter stationes ipsas et ordines planetarum. Stellæ autem invisibiles fiunt, aut propter corporis parvitatem, aut propter opacitatem (nam tenuitatis nomen non admodum approbamus, cum flamma pura sit corpus eximiæ tenuitatis), aut propter elongationem et distantiam. De auctario autem numeri astrorum per generationem stellarum novarum, quæstionem, ut prius, ad locum de Cometis rejicimus. Quod vero ad magnitudinem astrorum attinet, ea quæ est secundum apparentiam magnitudo pertinet ad phænomena, vera autem ad inquisitionem philosophicam, solo illo contenta

[1] Namely, a thousand and twenty-two.

problemate duodecimo:[1] *Quæ sit vera magnitudo cujusque astri, vel mensurata, vel saltem collata?* facilius enim est inventu et demonstratu, globum lunæ esse globo terræ minorem, quam globum lunæ in ambitu tot millia passuum continere. Itaque tentandum et contendendum ut exactæ magnitudines inveniantur; illæ si minus haberi possint, utendum comparatis. Capiuntur autem atque concluduntur magnitudines veræ, vel ab eclipsibus et umbris, vel ab extensionibus tam luminis quam aliarum virtutum quas corpora quæque pro ratione magnitudinis longius aut propius ejaculantur et diffundunt; vel postremo per symmetriam universi, quæ portiones corporum connaturalium ex necessitate quadam temperat et terminat. Minime vero standum iis quæ ab astronomis de veris magnitudinibus astrorum tradita sunt (licet videatur esse res magnæ et accuratæ subtilitatis) satis licenter et incaute; sed exquirendæ (si quæ se ostendunt) probationes magis fidæ et sinceræ. Magnitudo vero et distantia astrorum se invicem indicant ex rationibus opticis; quæ tamen et ipsæ excuti debent. Ista autem de vera magnitudine astrorum quæstio numero duodecima est. Sequitur quæstio altera de figura, *An astra sint globi?* hoc est, coacervationes materiæ in figura solida rotunda. Videntur autem ad apparentiam tres se ostendere figuræ astrorum; globosa et crinita, ut sol; globosa et angulata, ut stellæ (crines vero et anguli ad aspectum tantum referuntur, forma globosa tantum ad substantiam); globosa simpliciter, ut luna. Neque enim conspicitur stella oblonga, aut

[1] This problem would be the thirteenth if that which relates to the number of the stars is included in the enumeration. I am therefore inclined to think that it is not: the reason of the omission being that it is matter of direct observation.

triangularis, aut quadrata, aut alterius figuræ. Atque secundum naturam videtur ut massæ rerum majores, ad conservationem sui et veriorem unionem, se congregent in globos. Decima quarta quæstio pertinet ad distantiam; *Quæ sit vera distantia alicujus stellæ in profundo cœli?* Nam distantiæ planetarum tam ad invicem quam cum stellis fixis laterales sive per ambitum cœli reguntur a motibus earum. Quemadmodum autem superius de magnitudine astrorum diximus, si exacta magnitudo et plane mensurata haberi non possit, utendum esse magnitudine comparata; idem de distantiis præcipimus; ut si exacte capi distantia non possit (exempli gratia a terra ad Saturnum, vel ad Jovem), tamen ponatur in certo Saturnum esse Jove sublimiorem. Neque enim systema cœli quoad interius, scilicet ordo planetarum quoad altitudines, omnino sine controversia est, neque quæ nunc obtinuerunt, olim credita sunt. Atque etiam adhuc lis pendet de Mercurio et Venere, utra sit sublimior. Inveniuntur autem distantiæ aut ex parallaxibus, aut ex eclipsibus, aut ex rationibus motuum, aut ex apparentiis diversis magnitudinum. Etiam alia auxilia huic rei comparanda sunt, quæ humana queat industria comminisci. Præterea crassitudines sive profunditates sphærarum pertinent etiam ad distantias.

THEMA CŒLI.

Cum vero tanta reperiantur undequaque incommoda, satis habendum si asseratur quippiam quod minus durum sit. Constituemus itaque et nos *Thema Universi*, pro modo historiæ quæ nobis hactenus cognita est; omnia integra servantes judicio nostro, postquam historia et per historiam philosophia nostra inductiva magis adulta sit. Proponemus autem primo quædam de materia cœlestium, unde motus et constructio ipsorum melius intelligi possit; postea de motu ipso (quod nunc præcipue agitur) quæ cogitata et visa nobis sunt proferemus. Videtur itaque natura rerum in dispertitione materiæ, disclusisse tenuia a crassis; atque globum terræ crassis, omnia vero ab ipsa superficie terræ et aquarum ad ultima cœli usque tenuibus sive pneumaticis assignasse; tanquam geminis rerum classibus primariis, non æquis scilicet sed convenientibus portionibus. Neque vero vel aqua in nubibus hærens vel ventus in terra conclusus naturalem et propriam rerum collocationem confundit. Hæc vero differentia tenuis vel pneumatici et crassi vel tangibilis omnino primordialis est, et ea qua maxime utitur *systema universi*. Sumpta autem est ex rerum conditione omnium simplicissima, hoc est copia et paucitate materiæ pro exporrectione sua. Pneumatica vero quæ hic apud nos inveniuntur (de iis loquimur

quæ simplicia et perfecta existunt, non composita et imperfecte mista) sunt plane illa duo corpora Aër et Flamma. Ea vero ut corpora plane heterogenea ponenda sunt, non ut vulgo putatur, quod flamma nil aliud sit quam aër incensus. His vero respondent in superioribus natura Ætherea et Siderea, sicut et inferioribus Aqua et Oleum, et magis in profundo Mercurius et Sulphur, et generaliter corpora cruda et pinguia, vel aliter corpora flammam exhorrentia et concipientia (sales vero compositæ naturæ sunt ex partibus crudis simul et inflammabilibus).[1] Istæ vero duæ magnæ rerum familiæ, Aërea et Flammea, videndum quo fœdere universi partem longe maximam occupaverint, et quas partes habeant in systemate. In aëre terræ proximo flamma vivit tantum vitam momentaneam, et affatim perit. Postquam autem aër cœperit esse ab effluviis terræ defæcatior et bene attenuatus, natura flammæ per varios casus tentat et experitur in aëre consistere, et quandoque acquirit durationem nonnullam, non ex successione ut apud nos, sed in identitate; quod in aliquibus cometis humilioribus ad tempus obtinet, quæ sunt mediæ fere naturæ inter flammam successivam et consistentem; non tamen figitur aut constat flammea natura, antequam perventum fuerit ad corpus lunæ. Eo loco flamma extinguibile illud deponit, et se tuetur utcunque; sed tamen infirma et sine vigore est ejusmodi flamma, et parum habens radiatio-

[1] Salt is mentioned here, because Mercury, Sulphur, and Salt are according to Paracelsus the three constituent principles of all substances. Bacon however, as we see in the *Historia Sulphuris, Mercurii et Salis*, of which only the aditus or preface has been preserved, refuses to recognise salt as a coordinate principle with the other two, "duo ex illis, Sulphurem scilicet et Mercurium (sensu nostro accepta) censemus esse naturas admodum primordiales et penitissimos materiæ schematismos. . . . Quod vero ad Salem attinet, alia res est."

nis, nec propria natura vivida, nec a contraria natura admodum excitata. Etiam integra non est, sed ex compositione cum substantia ætherea (qualis ibi invenitur) maculosa et interpolata. Neque in regione Mercurii admodum feliciter collocata est flamma, cum ex coadunatione sua parvum tantummodo planetam conficere potis sit, eumque cum magna et perturbata varietate et fluctu motuum, tanquam ignem fatuum, laborantem et conflictantem, nec se a solis præsidiis nisi per parva spatia disjungi sustinentem. Atque postquam ad regionem Veneris est ventum, incipit roborari flammea natura et clarescere, et in globum bene amplum congregari; qui tamen et ipse famulatur soli, et longius ab eo recedere exhorret. In Solis autem regione tanquam in solio collocatur flamma; media inter flammas planetarum, fortior etiam et vibrantior quam flammæ fixarum, propter majorem antiperistasin et intensissimam unionem. At flamma in regione Martis etiam robusta cernitur, solis vicinitatem rutilatione referens, sed jam sui juris, et quæ per integrum cœli diametrum se a sole disjungi patiatur. In regione atuem Jovis flamma contentionem paulatim deponens, magis placida videtur et candida, non tam ex natura propria (ut stella Veneris, quippe ardentior), sed ex natura circumfusa minus irritata et exasperata; in qua regione verisimile est, illud quod reperit Galilæus, cœlum incipere stellescere, licet per stellas parvitate sua invisibiles.[1] In Saturni autem regione rursus natura flammæ[2] videtur nonnihil languescere et hebescere; utpote et a solis auxiliis longius remota, et

[1] [*invisiles* in the original: a form of the word not recognised by Facciolati, but common, I believe, in Telesius. — *J. S.*] This reference to Jupiter's satellites shows that the *Thema Cœli* was written after the publication of the *Sydereus Nuncius*.

[2] So in the original: the true reading is probably *flammea*. — *J. S.*

a cœlo stellato in proximo exhausta. Postremo flammea et siderea natura, æthereæ naturæ victrix, cœlum dat stellatum, ex natura ætherea et siderea (quemadmodum globus terræ ex continenti et aquis) varie sparsis conflatum, versa tamen et subacta atque adeo assimulata [1] substantia ætherea, ut sidereæ sit prorsus patiens et subserviens. Itaque tres reperiuntur a terra ad fastigia cœli regiones generales, et tria tanquam tabulata, quoad naturam flammeam. Regio extinctionis flammæ; regio coadunationis flammæ; et regio dispersionis flammæ. Atque de contiguo et continuo argutari in corporibus mollibus et fluoribus, plebeium omnino foret. Illud tamen intelligendum, consuesse naturam ad spatia quædam per gradus, deinde subito per saltus procedere, atque hujusmodi processum alternare; aliter nulla posset fieri fabrica, si per gradus insensibiles perpetuo procederetur. Quantus enim saltus (quoad explicationem materiæ) a terra et aqua ad aërem vel maxime crassum et nebulosum? Atque hæc tamen natura tam distantia corpora loco et superficie conjunguntur, sine medio aut intervallo. Nec minor saltus (quoad naturam substantialem) a regione aëris ad regionem lunæ: ingens similiter a cœlo lunæ ad cœlum stellatum. Itaque si quis continuum et contiguum acceperit non ex modo nexus, sed ex diversitate corporum connexorum, tres illæ [2] quas diximus regiones in limitibus suis pro contiguis tantum haberi queant. Jam vero videndum liquido et perspicue, hæc nostra de substantiis systematis theoria, quæ et qualia neget, et quæ et qualia affirmet, ut facilius teneri vel destrui possit. Negat illud vulgatum, *flammam esse aërem incensum;*

[1] So in the original: a mistake I suppose for *assimilata*. — *J. S.*
[2] *illas* in the original. — *J. S.*

affirmando corpora illa duo Aërem et Flammam plane esse heterogenea, instar Aquæ et Olei, Sulphuris et Mercurii. Negat *vacuum illud coacervatum Gilberti inter globos sparsos*, sed spatia vel aërea vel flammea natura repleri. Negat *lunam esse corpus aqueum vel densum vel solidum*, sed ex natura flammea licet lenta et enervi, primum scilicet rudimentum et sedimentum ultimum flammæ cœlestis; cum flamma (secundum densitatem), non minus quam aër et liquores, innumeros recipiat gradus. Affirmat, *flammam vere et libenter locatam figi et constare*, non minus quam aërem vel aquam, nec esse rem momentaneam et successivam tantum in mole sua, per renovationem et alimentum, ut hic fit apud nos. Affirmat, *flammam habere naturam coitivam vel congregativam in globos*, quemadmodum natura terrea, minime similem aëri et aquæ, quæ congregantur in orbibus et interstitiis globorum, sed nusquam in globos integros. Affirmat, *eandem naturam flammeam in loco proprio (id est cœlo stellato) spargi glomerationibus infinitis*, ita tamen ut non exuatur dualitas illa, ætheris et sideris, nec continuetur flamma in empyreum integrum. Affirmat, *sidera veras flammas esse*, sed actiones flammæ in cœlestibus neutiquam trahendas ad actiones flammæ nostræ, quarum pleræque per accidens tantum perfunguntur. Affirmat, *ætherem interstellarem et sidera habere rationes ad invicem aëris et flammæ, sed sublimatas et rectificatas.* Atque de substantia Thematis sive Systematis Universi, hujusmodi quædam occurrunt. Nunc de motibus cœlestium dicendum, cujus gratia hæc adduximus. Consentaneum videtur ut quies non tollatur e natura, secundum aliquod totum (nam de particulis nunc non est sermo). Hoc (missis argutiis dialecticis et mathematicis) ex eo maxime liquet, quod

incitationes et celeritates motuum cœlestium remittant se per gradus, ut desituræ in aliquod immobile; et quod etiam cœlestia participant ex quiete secundum polos; et quod si tollatur immobile, dissolvitur et spargitur systema. Quod si sit coacervatio quædam et massa naturæ immobilis, non videtur ulterius quærendum, quin ea sit globus terræ. Compactio enim densa et arctata materiæ inducit dispositionem erga motum torpescentem et aversam; quemadmodum contra, explicatio laxa promptam vel habilem. Neque male introducta est a Telesio (qui instauravit philosophiam Parmenidis et disputationes in libro de *primo frigido*) in naturam, non certe coëssentialitas et conjugatio (quod ille vult), sed tamen affinitas et conspiratio; videlicet ex altera parte, Calidi, Lucidi, Tenuis et Mobilis, et ex parte opposita, Frigidi, Opaci, Densi, et Immobilis; ponendo sedem primæ conspirationis in cœlo, secundæ in terra. Quod si ponatur *quies et immobile*, videtur etiam poni debere *motus absque termino et summe mobile*, maxime in naturis oppositis. Is motus est fere rotationis, qualis invenitur in genere in cœlestibus. Agitatio enim in circulo terminum non habet, et videtur manare ex appetitu corporis, quod movet solummodo ut moveat et se sequatur, et proprios petat amplexus, et naturam suam excitet, eaque fruatur, et propriam operationem exerceat; cum contra, latio in recta, itineraria videatur, et movere ad terminum cessationis sive quietis, et ut aliquid assequatur et dein motum suum deponat. Itaque de motu isto rotationis, qui est motus verus et perennis et cœlestibus vulgo putatur proprius, videndum quomodo se expediat, et quo moderamine se incitet et frænet, et qualia omnino patiatur. Quæ dum explicamus, formositatem illam mathematicam (ut motus reducantur ad circulos per-

fectos, sive eccentricos sive concentricos), et magniloquium illud (quod terra sit respectu cœli instar puncti, non instar quanti), et complura alia astronomorum inventa commentitia, ad calculos et tabulas relegabimus. At primo motus cœlestium dividemus. *Alii cosmici sunt, alii ad invicem.* Eos dicimus *cosmicos*, quos cœlestia ex consensu non cœlestium tantum, sed universitatis rerum nanciscuntur. Eos *ad invicem*, in quibus alia corpora cœlestia ex aliis pendent. Atque vera et necessaria est ista divisio. Terra itaque stante (id enim nunc nobis videtur verius),[1] manifestum est cœlum motu diurno circumferri, cujus motus mensura est spatium viginti quatuor horarum vel circiter: consequentia autem ab oriente in occidentem; conversio super puncta certa (quos polos vocant) australe et boreale. Etenim non jactantur cœli super polos mobiles, nec rursus alia sunt puncta quam quæ diximus. Atque hic motus vere videtur cosmicus, atque ideo unicus, nisi quatenus recipit et decrementa et declinationes; secundum quæ decrementa et declinationes transverberat motus iste universum rerum mobilium, et permeat a cœlo stellato usque ad viscera et interiora terræ; non raptu aliquo prehensivo aut vexativo, sed consensu perpetuo. Atque iste motus in cœlo stellato perfectus est et integer, tam mensura justa temporis quam restitutione plena loci. Quanto autem deceditur e sublimi, tanto iste motus imperfectior est, respectu tarditatis, et respectu etiam aberrationis a motu circulari. Ac primo de tarditate

[1] Bacon, in his later writings, rejected more decidedly than in this passage the doctrine of the earth's motion. Thus in the *Nov. Org.* ii. 46., it is said that Galileo's theory of the tides is founded on a "concessum non concessibile," namely, that the earth moves; and, in the third book of the *De Augmentis*, Bacon, in speaking of the cumbrous machinery of the Ptolemaic system, remarks, "harum suppositionum absurditas in motum terræ diurnum (quod nobis constat falsissimum esse) homines impegit."

dicendum separatim. Affirmamus Saturnum motu diurno tardius moveri, quam ut circumferatur aut restituatur ad idem punctum intra viginti quatuor horas, sed cœlum stellatum incitatius ferri, et prævertere Saturnum eo excessu, qui intra tot dies quot annos conficiunt triginta, universo cœli ambitui respondeat. Similiter de reliquis planetis dicendum, pro diversitate periodorum cujusque planetæ; adeo ut motus diurnus cœli stellati (in ipsa periodo, absque respectu ad magnitudinem circuli) sit fere per horam unam velocior quam motus diurnus lunæ. Si enim luna cursum suum 24 diebus posset expedire, tum excessus ille horæ integræ foret. Itaque motus decantatus *adversitatis et renitentiæ* ab occidente in orientem, qui attribuitur planetis tanquam proprius, verus non est, sed tantum per apparentiam, ex præcursione cœli stellati occidentem versus, et relictione a tergo planetarum versus orientem. Quo posito, manifestum est velocitatem istius motus cosmici, ordine non perturbato, descendendo decrescere, ut quo propius quique planeta appropinquet ad terram, eo tardius moveat; cum recepta opinio ordinem perturbet et invertat; et motum proprium tribuendo planetis, in illud absurdum incidat, ut planetæ, quo propinquiores sint ad terram (quæ est sedes naturæ immobilis) eo velocius moveri ponantur, id quod per remissionem violentiæ primi mobilis, astronomi excusare nugatorie et infeliciter conantur. Quod si cui mirum videatur, tantis spatiis quanta sunt a cœlo stellato ad lunam, motum istum tam parvis partibus, minus scilicet hora una, quæ est motus diurni pars 24^{a}, decrescere: succurrit illud, quod singuli planetæ minores circulos, quo terræ propiores sint, conficiant, et breviore ambitu rotent; ut addito decremento magnitudinis circuli ad decremen-

tum temporis sive periodi, motus iste insigniter decrescere cernatur. Atque hactenus de velocitate seorsim locuti sumus, perinde ac si planetæ (positi, exempli gratia, sub æquinoctio, aut aliquo ex parallelis) anteverterentur tantum a cœlo stellato, et ab invicem, sed tamen sub eodem illo circulo. Hæc enim simplex foret relictio absque obliquitate. At manifestum est, planetas non solum impari gradu contendere, sed nec ad idem punctum circuli reverti, verum deflectere versus austrum et boream, cujus deflexionis limites sunt tropici; quæ deflexio nobis Circulum Obliquum, et Diversam Politatem ejus progenuit; quemadmodum illa celeritatis inæqualitas motum illum Renitentiæ. Neque vero hoc etiam commento naturæ rerum opus est, cum recipiendo lineas spirales (id quod proxime accedit ad sensum et factum) res transigatur, et ista salventur. Atque (quod caput rei est) spiræ istæ nil aliud sunt quam defectiones a motu circulari perfecto, cujus planetæ sunt impatientes. Prout enim substantiæ degenerant puritate, et explicatione, ita degenerant et motus. Evenit autem, quemadmodum in celeritate sublimiores planetæ feruntur velocius, humiliores tardius, ita etiam ut sublimiores planetæ propiores conficiant spiras, quæque circulos propius referant; humiliores vero, spiras magis disjunctas et hiantes. Deceditur enim perpetuo descendendo magis ac magis et a flore illo velocitatis et a perfectione motus circularis, ordine nusquam perturbato. In eo tamen planetæ conspirant (utpote corpora multum retinentia naturæ communis, licet aliter differentia) ut habeant eosdem limites deflexionis.[1] Neque enim Saturnus intra tropicos remeat, neque Luna extra

[1] It appears from this that Bacon was not aware of the obliquity to the ecliptic of all the planetary orbits.

Tropicos exspatiatur (et tamen de exspatiatione stellæ Veneris non negligendum quod ad aliquibus traditum et notatum est), sed universi planetæ, sive sublimiores sive humiliores, postquam ad tropicos perventum est se vertunt et retexunt, pertæsi minoris spiræ, qualis subeunda foret si polis magis appropinquarent; eamque jacturam motus, veluti destructionem naturæ suæ, exhorrentes. Utcunque enim in cœlo stellato et stellæ prope polos et stellæ circa æquinoctium ordines et stationes suas servant, aliæ ab aliis in ordinem redactæ, summa et æquabili constantia; planetæ nihilominus videntur esse hujusmodi mixtæ naturæ, ut nec breviorem gyrum omnino, nec ampliorem libenter ferant. Atque ista videntur nobis paulo meliora circa motus cœlestes, quam raptus et motuum repugnantia, et diversa politas zodiaci, et inversus ordo celeritatis, et hujusmodi, quæ nullo modo cum natura rerum conveniunt, licet pacem qualem qualem colant cum calculis. Neque ista non viderunt astronomi præstantiores; sed arti suæ intenti, et circa perfectos circulos inepti, et subtilitates captantes, et philosophiæ malum[1] morigeri, naturam sequi contempserunt. Verum istud sapientium arbitrium imperiosum in naturam, est ipsa vulgi simplicitate et credulitate deterius; si quis manifesta, quia sunt manifesta, fastidit.[2] Et tamen ingens est illud malum, et latissime patet; ut ingenium humanum, cum par rebus esse non possit, supra res esse malit. Jam vero inquirendum utrum motus iste unicus et simplex, in circulo et spira, ab oriente in occidentem, super polos certos australem et borealem, desinat et terminetur cum cœlo, an etiam

[1] M. Bouillet corrects this into *male*, remarking "vulgo legitur malum quod construi nequit." He was apparently not aware that *malum* is used adverbially. If any change were made, I should prefer to read *malæ*.

[2] *fastidii* in the original: first corrected, I believe, by Birch. — *J. S.*

deducatur ad inferiora. Neque enim liberum erit hujusmodi placita confingere hic in proximo, qualia supponunt in cœlestibus. Itaque si in his regionibus quoque reperiatur ille motus, apparebit etiam in cœlo eum talem esse secundum naturam communem sive cosmicam, qualem nos illam experimur. Primo itaque plane constat, illum cœli terminis non contineri. Verum hujusce rei demonstrationes et evidentias in Anticipatione nostra de Fluxu et Refluxu Maris plene tractavimus; itaque ad illam homines rejicimus; et hoc velut posito et concesso, ad reliquos motus cœlestium pergemus. Eos autem non Cosmicos, sed ad invicem esse diximus. Quatuor sunt genera motuum in cœlestibus visibilium, præter eum quem diximus Cosmicum, qui est motus diurnus per spiras intra tropicos. Aut enim attolluntur stellæ altius, et rursus demittuntur humilius, ut sint longius et propius a terra: aut flectunt se et sinuant per latitudinem zodiaci, excurrendo magis ad austrum aut magis ad boream, atque efficiendo eos quos vocant Dracones: aut incitatione atque etiam consecutione motus (hæc enim duo conjungimus) variant, gradiendo aliquando celerius, aliquando tardius, aliquando in progressu, aliquando in regressu, aliquando etiam stando et morando; aut ad distantiam aliquam a sole magis aut minus alligantur et circumscribuntur. Horum causas et naturas reddemus tantum in genere et per capita; id enim hoc loco nostrum postulat institutum. Verum ad hoc ut viam præmuniamus et aperiamus, dicendum aperte quid sentiamus de quibusdam tam placitis philosophicis quam hypothesibus astronomicis, et de observationibus etiam astronomorum per varia secula, ex quibus artem suam instaurant; quæ omnia videntur nobis esse erroris et confusionis plena. Sunt itaque axiomata sive

potius placita nonnulla, quæ a philosophis accepta, et in astronomiam translata, et male credita, artem corruperunt. Simplex autem erit rejectio et judicium nostrum; neque enim tempus refutationibus terere convenit. Horum primum est, quod omnia supra lunam inclusive sint incorruptibilia, neque novas generationes aut mutationes ullo modo patiantur. De quo alibi dictum est, quod sit superstitio et vaniloquium. Verum ex hoc fonte illud ingens malum, quod ex omni anomalia novas atque (ut putant) emendatas confingant astronomi theorias, et rebus sæpius tanquam fortuitis applicant causas æternas et invariabiles. Secundum est, quod cœlo (cum sit scilicet ex essentia quinta et minime elementari) non competant actiones illæ turbulentæ, compressionis, relaxationis, repulsionis, cessionis, et similium, quæ videntur progigni a mollitia quadam corporum et duritia, quæ habentur pro qualitatibus elementaribus. Hæc vero assertio est abnegatio insolens et licentiosa rerum et sensus. Ubicunque enim corpus naturale positum sit, ibi est antitypia quoque, idque pro modo corporis. Ubicunque vero corpora naturalia et motus localis, ibi vel repulsio, vel cessio, vel sectio; hæc enim quæ dicta sunt, compressio, relaxatio, repulsio, cessio, cum multis aliis, sunt passiones materiæ catholicæ ubique locorum. Attamen ex hoc fonte nobis emanavit illa multiplicatio circulorum perplexorum ad libitum, quos tamen volunt ita et consignari inter se, et alios intra alios moveri et verti tanto lævore et lubricitate, ut nulla nihilominus sit impeditio, nulla fluctuatio; quæ omnia phantastica plane sunt et rebus insultant. Tertium est, quod singulis corporibus naturalibus singuli competant motus proprii; et si plures inveniantur motus, omnes, excepto uno, sint aliunde, et ex movente aliquo separato. Quo falsius quic-

quid nec excogitari potest, cum universa corpora ex
tiplici rerum consensu motibus etiam pluribus pr
sint, aliis dominantibus, aliis succumbentibus, aliis
latentibus nisi provocentur; proprii autem rerum
nulli sint nisi mensuræ exactæ, et modi motuum co
nium. Atque hinc rursus nobis prodiit primum n
separatum, et cœli super cœlos, et inædificationes
continenter, ut motuum tam diversorum præstatic
sufficere possint. Quartum est, quod omnes motu
lestium dispensentur per circulos perfectos; quod
sum valde est, et portenta illa eccentricorum et epi
rum nobis peperit; cum tamen, si naturam consului
motus ordinatus et uniformis sit circuli perfecti;
vero ordinatus, sed multiformis, qualis invenitur i
lestibus compluribus, sit aliarum linearum; mer
Gilbertus hæc deridet, quod non verisimile sit na
confinxisse rotas, quæ, exempli gratia, in circuitu
tineant milliare unum aut alterum, ad hoc ut f
pila palmaris.[1] Tantulæ enim magnitudinis videtu
corpus planetæ ad eos quos ad deferendum illud fi
circulos. Quintum est, quod stellæ sint partes or
tanquam clavo fixæ. Hoc vero evidentissime est
mentum eorum qui mathemata, non naturam tra
atque motum corporum tantum stupide intuentes
stantiarum omnino obliviscuntur. Ista enim f
particularis est affectus rerum compactarum et
tentium, quæ firmas habent prehensiones ob pre
partium. Inopinabile autem prorsus est si transf
ad mollia vel liquida. Sextum est, quod stella si
sior pars orbis sui; illæ vero neque partes sunt,
densiores.[2] Non enim homogenea sunt cum æth
gradu tantum, sed plane heterogenea, et substant

[1] Physiologia Nova, ii. 11. [2] See Arist. De Cœlo, i

ferunt; atque ea quoque substantia quoad densitatem rarior est et magis explicata quam ætherea. Sunt et alia complura placita ejusdem vanitatis; sed hæc ad id quod agitur sufficient. Atque hæc de placitis philosophiæ circa cœlestia dicta sint. Quod vero ad hypotheses astronomorum attinet, inutilis fere est earum redargutio, quæ nec ipsæ pro veris asseruntur, et possint esse variæ, et inter se contrariæ, ut tamen phænomena æque salvent et concinnent. Itaque sit cautum, si placet, inter astronomiam et philosophiam, tanquam fœdere convenienti et legitimo, ut scilicet astronomia præhabeat hypotheses quæ maxime expeditæ sunt ad compendia computandi, philosophia eas quæ proxime accedunt ad veritatem naturæ; atque ut astronomiæ hypotheses rei veritati non præjudicent, et philosophiæ decreta talia sint, quæ sint super phænomena astronomiæ explicabilia. Atque de hypothesibus ita esto. At de observationibus astronomicis quæ accumulantur assidue, quæque jugiter a cœlo tanquam aquæ scaturiunt, illud omnino homines monitos volumus; ne forte de illis verum sit quod eleganter fingitur de musca Æsopi, quæ sedens super temonem currus Olympici, Quantum, inquit, pulverem ego excito? Ita observatio aliqua pusilla, eaque quandoque instrumento, quandoque oculō, quandoque calculo titubans, quæque possit esse propter veram aliquam in cœlo mutationem, novos cœlos et novas sphæras et circulos excitat. Neque hæc eo dicimus, quod remitti debeat aliqua industria observationum et historiæ, quam omnibus modis acuendam et intendendam esse dicimus, sed tantummodo ut adhibeatur prudentia et summa et sedata judicii maturitas, in abjiciendis aut mutandis hypothesibus. Itaque patefacta jam via, de motibus ipsis dicemus pauca et in genere. Quatuor autem gen-

era esse diximus motuum majorum in cœlestibus. *Motum per profundum cœli* attollentem et demittentem; *motum per latitudinem zodiaci* exspatiantem ad austrum et boream; *motum per consequentiam zodiaci*, citum, tardum, progressivum, retrogradum, statarium; et *motum elongationis* a sole. Neque objiciat quispiam, motum illum secundum latitudinis, sive draconum, potuisse referri ad motum illum magnum cosmicum, cum sit inclinatio alternans versus austrum et boream, quod et spiræ illæ de tropico in tropicum similiter sunt, nisi quod ille motus sit tantum spiralis, iste vero etiam sinuosus et minoribus multo intervallis. Neque enim hoc nos fugit. Sed plane non sinit constans et perpetuus motus solis in ecliptica absque latitudine et draconibus, qui tamen sol communicat cum cæteris planetis quoad spiras inter tropicos, nos in hac opinione versari. Itaque alii fontes et hujus et reliquorum trium motuum quærendi sunt. Atque hæc sunt illa, quæ circa motus cœlestium nobis videntur minus habere incommodi. Videndum vero quid negent, et quid affirment. Negant *terram rotare.* Negant *esse in cœlestibus duos motus ab oriente in occidentem alterum;*[1] atque affirmant *anteversionem et relictionem.* Negant *obliquum circulum et diversam politatem ejus;* et affirmant *spiras.* Negant *primum mobile separatum et raptum:* et affirmant *consensum cosmicum tanquam commune vinculum systematis.* Affirmant *motum diurnum inveniri non in cœlo, sed et in aëre, aquis, etiam extimis terræ, quoad verticitatem.* Affirmant *consecutionem et volubilitatem illam cosmicam in fluidis, esse verticitatem et directionem in consistentibus, usque quo perveniatur ad immobile sincerum.* Negant

[1] So in the original. Supply, according to M. Bouillet's suggestion, *alterum ab occidente in orientem.* — *J. S.*

stellas figi tanquam nodos in tabula. Negant *eccentricos, epicyclos, et hujusmodi fabricas esse reales.* Affirmant *motum magneticum sive congregativum vigere in astris, ex quo ignis ignem evocat et attollit.* Affirmant *in cœlis planetarum corpora planetarum velocius moveri et rotare quam reliquum cœli ubi siti sunt, quod utique rotat, sed tardius.* Affirmant *ex ea inæqualitate fluctus et undas et reciprocationes œtheris planetarum, atque ex iis varios motus educi.* Affirmant *necessitatem in planetis volvendi celerius et tardius, prout locantur in cœlo sublimius aut humilius, idque ex consensu universi.* Sed simul affirmant *tædium præternaturalis incitationis in planetis et majoris et minoris circuli.* Affirmant *solisequium ex natura inopiosa in ignibus infirmioribus Veneris et Mercurii;* cum etiam inventæ sint a Galilæo stellulæ errantes Jovis asseclæ. Ista autem nos tanquam in limine historiæ naturalis et philosophiæ stantes prospicimus, quæ quanto quis magis se immerserit in historiam naturalem, tanto fortasse probabit magis. Attamen testamur iterum nos hic teneri nolle. In his enim, ut in aliis, certi viæ nostræ sumus, certi sedis nostræ non sumus. Hæc vero interfati sumus, ne quis existimet nos vacillatione judicii aut inopia affirmandi negativas quæstiones malle. Itaque tenebimus, quemadmodum cœlestia solent (quando de iis sermo sit), mobilem[1] constantiam.

[1] ["nobilem" in the original.] The sense requires *mobilem*, and the antithesis *mobilis constantia* is I think quite in Bacon's manner.

DE

INTERPRETATIONE NATURÆ

SENTENTIÆ XII.

PREFACE

TO THE

DE INTERPRETATIONE NATURÆ

SENTENTIÆ XII.

THE next piece is not properly a fragment, being complete in itself. It is one of the many drafts of that great "speech of preparation" which Bacon turned into so many different shapes before it issued finally in the first book of the *Novum Organum*. Of the rejected forms this is perhaps the most remarkable for weight, condensation, and comprehensiveness. It was first published by Gruter in 1653, who places it among the *Impetus Philosophici;* and though the typographical arrangement makes it seem to be connected with the *Tradendi Modus legitimus* which follows, I think this must have been by accident or error. It exactly answers to its own title, which contains nothing that should lead one to expect a sequel; while on the other hand there is nothing in the *Tradendi Modus legitimus* which seems to require an introduction.

Considering it then as a separate piece, there seem to be no data for determining when it was composed; though, judging by the form and style, I am myself inclined to refer it to the period when Bacon thought of throwing the exposition of his argument into a dra-

matic form; the rather because the allusions t
ordinatæ chartarum sequelæ, the *coordinationes*, *reo*
tiones, *chartæ novellæ*, &c. belong to the days ‹
Filum Labyrinthi, when he was more occupied ir
fecting and explaining his *method* than in taking
for collecting a natural history, — not having the
ceived so fully as I think he afterwards did, how
of the Labyrinth must be explored before the clue
be obtained or used.

Both this piece and the *Aphorismi et Consilia*
follow have been printed by M. Bouillet as parts
Temporis Partus Masculus; which he assumes
the same work which Bacon says he composed
age of twenty-four, under the title of *Temporis P*
Maximus. My reasons for disagreeing with hi
both points have been already stated.[1]

J.

[1] See above, p. 7., and Vol. I. p. 179.

DE INTERPRETATIONE NATURÆ

SENTENTIÆ XII.

De conditione hominis.

1. Homo, naturæ minister et interpres, tantum facit aut intelligit, quantum de naturæ ordine re vel mente observabit, ipse interim naturæ legibus obsessus.

2. Terminus itaque humanæ potentiæ ac scientiæ in dotibus quibus ipse præditus est a natura ad movendum et percipiendum, tum etiam in statu rerum præsentium. Ultra enim has bases illa instrumenta non proficiunt.

3. Dotes hæ per se tenues et ineptæ, rite tamen et ordine administratæ tantum possunt, ut res a sensu et actu remotissimas judicio et usui coram sistant, majoremque et operum difficultatem et scientiæ obscuritatem superent, quam quis adhuc optare didicerit.

4. Una veritas, una interpretatio: sensus autem obliquus, animus alienus, res importuna, ipsum tamen interpretationis opus magis declinans quam difficile.[1]

De impedimentis interpretationis.

5. Quisquis dubitationis impos et asserendi avidus principia demum statuet probata (ut credit) concessa et manifesta, ad quorum immotam veritatem cætera ut

[1] Compare *Cogitata et Visa* (supra, p. 138.): *Nunc autem apparere viam non aliqua mole aut strue imperviam, sed ab humanis vestigiis deviam esse.* — *J. S.*

pugnantia vel obsecundantia recipiet vel rejiciet, is res cum verbis, rationem cum insania, mundum cum fabula commutabit, interpretari non poterit.

6. Qui omnem rerum distinctionem, quæ in constitutis vulgo speciebus vel etiam inditis nominibus elucescit, non miscuerit, confuderit, et in massam redegerit, non unitatem naturæ, non legitimas rerum lineas videbit, non interpretari poterit.

7. Qui primum et ante alia omnia animi motus humani penitus non explorarit, ibique scientiæ meatus et errorum sedes, accuratissime descriptas non habuerit, is omnia larvata et veluti incantata reperiet, fascinum ni solverit interpretari non poterit.

8. Qui in rerum obviarum et compositarum causis exquirendis, veluti flammæ, somnii, febris, versabitur, nec se ad naturas simplices conferet; ad istas primo quæ populari ratione tales sunt, deinde etiam ad eas quæ arte ad veriorem simplicitatem reductæ sunt et veluti sublimatæ; is fortasse, si cætera non peccat, addet inventis quædam non spernenda, et inventis proxima. Sed nil contra majores rerum secularitates [1] movebit, nec Interpres dicendus erit.

De moribus interpretis.

9. Qui ad interpretandum accesserit, ita se comparet et componat. Sit nec novitatis, nec consuetudinis vel antiquitatis sectator, nec contradicendi licentiam, nec authoritatis servitutem amplectatur. Non affirmandi sit properus, nec in dubitationem solutus, sed singula gradu quodam probationis insignita provehat. Spes ei laboris, non otii author sit. Res non raritate, difficul-

[1] Popular opinions, or such as flourish in the *sæculum* or world, or through ages, *sæcula*. See Vossius.

tate, aut laude, sed veris momentis æstimet. Privata negotia personatus[1] administret, rerum tamen provisus subvenerans. Errorum in veritates et veritatum in errores subingressus prudenter advertat, nihil contemnens aut admirans. Naturæ suæ commoditates norit. Naturæ aliorum morem gerat, cum nemo lapidi impingenti succenseat. Uno veluti oculo rerum naturas, altero humanos usus pererret. Verborum mixtam naturam, et juvamenti et nocumenti inprimis participem, distincte sciat. Artem inveniendi cum invento adolescere statuat. Sit etiam in scientia quam adeptus est nec occultanda nec proferenda vanus, sed ingenuus et prudens, tradatque inventa non ambitiose aut maligne, sed modo primum maxime vivaci et vegeto, id est ad injurias temporis munitissimo, et ad scientiam propagandam fortissimo, deinde ad errores pariendos innocentissimo, et ante omnia, qui sibi legitimum lectorem seponat.

De officio interpretis.

10. Ita moratus et comparatus interpres ad hunc modum procedat. Conditionem hominis reputabit, impedimenta interpretationis removebit, tum ad opus accinctus historiam parabit et ordinatas chartarum sequelas, unaque usus, co-ordinationes, occurrentias et schedulas

[1] That is, I apprehend, affecting more interest in them than he feels. Compare Cicero's phrase, "Cur ego personatus ambulem?" — *Ep. ad Att.* xv. 1. [Rather, I should think, "speaking to people in their own language." I cannot say that I clearly understand the sentence; but I think it must refer to the necessity of using popular ideas for popular purposes. Compare *Redargutio Philosophiarum* (supra, p. 63.): *Servate itaque illam alteram* (*i. e.* the popular philosophy), *et prout commodum vobis erit adhibete; atque aliter cum natura aliter cum populo negotiamini. Nemo enim est qui plus multo quam alius quis intelligit, quin ad minus intelligentem* tanquam personatus sit, *ut se exuat, alteri det.* I am inclined to think that there should be a full stop after *administret*, and a comma after *subvenerans*. — *J. S.*]

instituet. Rerum solitudinem et sui similitudinem
ræsentabit. Quin et rerum delectum habebit, qu
maxime primitivæ sunt vel instantes, id est vel r
aliarum inventioni, vel humanis necessitatibus præ
conducunt, præordinabit. Instantiarum etiam pr
inentias[1] observabit, quæ ad operis compendium
rimum possunt. Atque ita instructus re-ordina
demum, et chartas novellas, ac ipsam interpretati
facilem jam et sponte sequentem, imo mente fere
reptam, mature et feliciter aggredietur et per
Quod ubi fecerit, continuo veros, æternos, et si
cissimos naturæ motus, ex quorum ordinato et ca
tissimo progressu infinita hæc tum præsentis tum
ævi varietas emergit, pura et nativa luce videbit
merabit. Interimque ab initio operis humanis
multa et incognita, veluti fœnus, assidue reciper
omittet. Sed hinc denuo totus in humanos usus r
que præsentium statum conversus et intentus,
diversa via et ad actionem ordinabit et disponet.
turis secretissimis alias declaratorias, et absenti
alias superinductorias assignabit. Et deinde ta
veluti altera natura plerumquitates condet, quaru
rores pro monstris sint, salva etiam tamen sibi
prærogativa.

De provisu rerum.

11. Tu autem spe et studio languidis hæc
(fili) mirarisque si tanta supersit operum fructuosi
rum et prorsus incognitorum ubertas, ea non an
aut jam subito esse inventa; simul etiam cujusm
sint, nominatim requiris, visque tibi aut immortali
aut indolentiam, aut voluptatem transportantem pr

[1] To these Bacon afterwards gave the name of Prerogativæ

Verum tu tibi largire (fili) spemque ex scientia aucupabere, ut ex ignorantia desperationem cepisti.[1] An etiam arte adoptandum est opus? At dubitationi tuæ quoad licet satisfaciam, moremque tibi geram. Quod hæc subito nota sint, nil mirum, fili. Scientia celeris, tempus tardi partus est. Etiam nobilia quæ ante hæc inventa sunt, non luce prioris cognitionis sensim, sed casu (ut loquuntur) affatim inventa sunt. In mechanicis autem est quædam rei jam inventæ extensio, sed novæ inventionis nomen non meretur. Non longum (fili) sed ambiguum est iter. Quod autem hæc non ante hoc tempus in conspectum se dedisse ais,[2] an tibi compertum est quantum omni antiquitati, vel omnibus in regionibus, vel etiam singulis hominibus innotuerit? Sed fere assentior tibi (fili) teque altius manu ducam. Non dubitas quin si homines non forent, multa eorum quæ arte (ut loquuntur) facta sunt, defutura fuissent, ut statuam marmoream, stragulam vestem. Age vero, et homines an non habent et ipsi suos motus quibus obtemperant? Sane (fili) magis subtiles, et difficilius a scientia comprehensos, sed æque certos. Profecto, inquies, homines voluntati parent. Audio, sed hoc nihil est. Qualis causa est fortuna in universo, talis est voluntas in homine.[3] Si quid ergo nec sine homine producitur, et jacet etiam extra hominis vias, an non nihilo æquale est? Homo etiam in quædam veluti occurrentia impingit, alia fine præviso et mediis cognitis exequitur. Mediorum tamen notitiam ex obviis sumit. Quo igitur in numero reponentur ea, quæ nec effectum obvium, nec operationis modum et lucem ex obviis

[1] *cœpisti* in the original. — *J. S.*

[2] *aio* in the original. — *J. S.*

[3] Fortune is spoken of in the *Nov. Org.* (i. 60.) as nomen rei quæ non est.

sortiuntur. Talia opera *Epistemides* vocantur, id est scientiæ filiæ, quæ non alias in actum veniunt quam per scientiam et interpretationem meram, cum nihil obvii contineant. Inter hæc autem et obvia quot gradus numerari putas? Tene (fili) et obsigna.

12. Postremo loco tibi consulo (fili) quod facto imprimis opus est, hoc est, ut mente illuminata et sobria interpretationem rerum divinarum et naturalium distinguas, neve has ullo modo inter se committi patiare. Satis erratum est in hoc genere. Nihil hic nisi per rerum inter se similitudines addiscitur. Quæ licet dissimillimæ videantur, premunt tamen similitudinem germanam interpreti notam. Deus autem sibi [1] tantum similis est absque tropo. Quare nullam ad ejus cognitionem hinc lucis sufficientiam expecta. Da fidei, quæ fidei sunt.

[1] *tibi* in the original. — *J. S.*

APHORISMI ET CONSILIA.

PREFACE

TO THE

APHORISMI ET CONSILIA.

THE fragment which follows stands in Gruter's volume (in which it first appeared) immediately before the *Sententiæ XII.*; but there is evidently no connexion between the two, and I conclude that this was the later written from its nearer resemblance to the *Novum Organum* in those passages which occur in all three, and can be compared.

When it was written is another question, and one on which I can offer no opinion. A memorandum in the *Commentarius Solutus*, 26. July, 1608, — "The finishing of the *Aphorisms*, Clavis Interpretationis, and then setting forth of the book," — refers no doubt to some paper of the kind; some early rudiment of the *Novum Organum*; but it is impossible to say whether the *Aphorisms* alluded to are these or not. The note at the end, *reliqua non erant perfecta*, implying that the paper had been laid by in its unfinished state, makes the memorandum particularly applicable to them. The notes to this are Mr. Ellis's.

J. S.

FRANCISCI BACONI

APHORISMI ET CONSILIA, DE AUXILIIS MENTIS,

ET

ACCENSIONE LUMINIS NATURALIS.

Homo, naturæ minister et interpres, tantum facit et intelligit, quantum de ordine naturæ opere vel mente observaverit; nec amplius novit aut potest.[1]

Manus hominis nuda, quantumvis robusta et constans, ad opera pauca et facile sequentia sufficit: eadem ope instrumentorum, multa et reluctantia vincit. Similis est et mentis ratio.

Instrumenta manus, motum aut cient aut regunt: et instrumenta mentis, intellectui aut suggerunt aut cavent.[2]

Super datam materiæ basim naturam quamvis imponere, intra terminos possibiles,[3] intentio est humanæ potentiæ. Similiter dati effectus in quovis subjecto causas nosse, intentio est humanæ scientiæ: quæ intentiones in idem coincidunt. Nam quod in contemplatione instar causæ est, in operatione instar medii est.[4]

Qui causam alicujus naturæ, veluti albedinis aut caloris, in certis tantum subjectis novit, ejus scientia im-

[1] Nov. Org. i. 1. [2] Ib. i. 2.

[3] So in the original. *Possibilis* is the reading in other places where the expression occurs, and probably the true reading here. — *J. S.*

[4] Ib. ii. 1. and i. 3.

perfecta est. Et qui effectum super certam t materiam ex iis quæ sunt susceptibiles inducere ejus potentia pariter est imperfecta.[1]

Qui causas naturæ alicujus in aliquibus subject tum novit, is efficientem aut materiatam causam quæ causæ fluxæ sunt, et nihil aliud quam vehic causæ formam deferentes. Qui autem unitate turæ in materiis dissimillimis comprehendit, is rerum novit.

Qui efficientes et materiatas causas novit, is j dem inventa componit aut dividit, aut transfe producit; etiam ad nova inventa in materia aliqu simili et præparata pertingit: terminos rerum fixos non movet.

Qui formas novit, is quæ adhuc facta non sunt, nec naturæ vicissitudines nec experimentales ind unquam in actum produxissent, neque cogitatione manam subitura fuissent, detegit et educit.

Eadem est veritatis et potestatis via et perfectic ipsa, ut formæ rerum inveniantur: ex quarum sequitur contemplatio vera et operatio libera.

Formarum inventio simplex est et unica, quæ dit per naturarum exclusionem sive rejectionem. nes enim naturæ, quæ aut data natura præsente a aut data natura absente adsunt, ex forma non atque post rejectionem aut negationem comp manet forma et affirmatio. Exempli gratia, si formam inquiras, et aquam calentem invenias n cidam, rejice lumen: si aërem tenuem invenia calidum, rejice tenuitatem. Hoc breve dictu es longo circuitu ad hoc pervenitur.[2]

[1] Nov. Org. ii. 3. to which correspond also the next four aph
[2] Ib. ii. 16.

Prolatio verborum contemplativa aut operativa re non differunt. Cum enim hoc dicis, Lumen non est ex forma caloris; idem est ac si dicas, In calore producendo non necesse est ut etiam lumen producas.[1]

Reliqua non erant perfecta.

Neque hæc numine nostro eunt. Tu, Pater, conversus ad opera quæ fecerunt manus tuæ, vidisti quod omnia essent bona valde: homo autem conversus ad opera quæ fecerunt manus suæ, vidit quod omnia essent vanitas et vexatio spiritus. Itaque si in operibus tuis sudabimus, facies nos gratulationis tuæ et sabbati tui participes. Supplices rogamus ut hæc mens nobis constet; atque ut per manus nostras familia humana novis eleemosynis tuis dotetur. Hæc æterno amori tuo commendamus, per Jesum nostrum, Christum tuum, nobiscum Deum.[2]

[1] Nov. Org. ii. 17.

[2] Compare the prayer with which the *Distributio Operis* concludes.

PHYSIOLOGICAL AND MEDICAL REMAINS.

PREFACE

TO THE

PHYSIOLOGICAL AND MEDICAL REMAINS.

THE following pieces were first published by Tenison in 1679, in a single volume entitled "Baconiana, or certain genuine Remains of Sir Francis Bacon Baron of Verulam and Viscount of St. Alban's; in arguments Civil, Moral, Natural, Medical, Theological, and Bibliographical; now for the first time faithfully published;" with an introduction professing to give "an account of all the Lord Bacon's works."

Tenison was intimate at college with William Rawley the Doctor's son, and afterwards with John Rawley his executor. Through them he had access to the Bacon manuscripts which had been left in the Doctor's hands, and may therefore be considered as an original authority in the matter. He was not a man of much sagacity or intellectual vigour; and there is reason to believe that he sometimes took leave to alter the text a little, when it contained expressions which he thought undignified. But he was a great venerator of Bacon, and upon the whole a careful, conscientious, and scholar-like editor. He assures us that he has printed nothing as Bacon's which he did not find either written in his own hand or transcribed by Dr. Rawley; and though

some of the manuscripts appear to have been in a condition which required more judgment in the decipherer than he could perhaps be trusted for (for he compares his labour in extracting the sense to that of reducing mercury to its proper form after its divers shapes and transmutations), yet, with some little allowance on that account, they may be all accepted as authentic.

Those which he has collected under the respective titles of Physiological and Medical Remains (the *Abecedarium Naturæ* excepted, which has been printed already) may be considered as loose notes or memoranda connected with the collection of Natural History; and as there are no means of guessing when they were written, this seems the fittest place for them. Being merely the remains of the collection from which Rawley had already selected all that he thought worth publishing, they are of little value, and little need be said about them.

They are all in Bacon's own English; except the latter portion of the *catalogue of bodies attractive and non-attractive*, which appears to have been written by him in Latin. Of the second — *articles of questions touching minerals* — a Latin translation by Rawley had been published in the *Opuscula Philosophica*, which I have not thought it necessary to reprint. The English original from which Tenison took it was one of three (he tells us); and the words "This is the clean copy" were written on the back of it in Bacon's own hand. These questions are not, I think, to be classed among the *Topicæ inquisitionis* which Bacon speaks of at the end of the *Parasceve;* they are not directions for the collection of a natural history of minerals *quæ sit in ordine ad condendam philosophiam*, but merely questions

with a view to obtain better and cheaper manufactures. They were referred to one Dr. Meverel, a chemist of that day, whose answers Tenison has printed along with them. These answers, as they may perhaps throw some light upon the state of chemical science in Ba con's time, I have appended as notes.

The *experiments about weight in air and water* have some interest in connexion with Bacon's method of determining specific gravities, as explained in the *Historia Densi et Rari;* concerning which Mr. Ellis has contributed a valuable note.

Among the Physiological Remains, Tenison has inserted a *speech touching the recovering of drowned mineral works*, fathered upon Bacon by Edward Bushel, a great projector of such things, who in his early youth had been in Bacon's service. His story is that this speech was prepared by Bacon for the Parliament of 1621. But Tenison evidently did not believe it to be genuine; and it is in fact so manifest a fabrication that I have not admitted it at all into this edition. It is obviously a mere puff of some project of Bushel's own.

The other pieces sufficiently explain themselves.

J. S.

INQUISITIONS

TOUCHING

THE COMPOUNDING OF METALS,

BY

SIR FRANCIS BACON, BARON OF VERULAM.[1]

To make proof of the incorporation of iron with flint, or other stone. For if it can be incorporated without over-great charge, or other incommodity, the cheapness of the flint or stone doth make the compound stuff profitable for divers uses. The doubts may be three in number.

First; Whether they will incorporate at all, otherwise than to a body that will not hold well together, but become brittle and uneven?

Secondly; Although it should incorporate well, yet whether the stuff will not be so stubborn as it will not work well with a hammer, whereby the charge in working will overthrow the cheapness of the material?

Thirdly; Whether they will incorporate, except the iron and stone be first calcined into powder? And if not, Whether the charge of the calcination will not eat out the cheapness of the material?

The *uses* are most probable to be; *First* for the im-

[1] Baconiana, p. 92.

plements of the kitchen; as spits, ranges, cobirons, pots, &c. *then* for the wars, as ordnance, portcullises, grates, chains, &c.

Note; the finer works of iron are not so probable to be served with such a stuff; as locks, clocks, small chains, &c., because the stuff is not like to be tough enough.

For the better use in comparison of iron, it is like the stuff will be far *lighter:* for the weight of iron to flint is double and a third part; and, secondly, it is like to rust not so easily, but to be *more clean.*

The ways of trial are two. *First*, by the iron and stone of themselves, wherein it must be inquired, what are the stones that do easiliest melt. *Secondly*, with an additament, wherein brimstone is approved to help to the melting of iron or steel. But then it must be considered, whether the charge of the additament will not destroy the profit.

It must be known also what proportion of the stone the iron will receive to incorporate well with it, and that with once melting; for if either the proportion be too small, or that it cannot be received, but piece-meal by several meltings, the work cannot be of value.

To make proof of the incorporating of iron and brass. For the cheapness of the iron in comparison of the brass, if the uses may be served, doth promise profit. The doubt will be touching their incorporating; for that it is approved that iron will not incorporate neither with brass nor other metals of itself by simple fire: so as the inquiry must be upon the calcination, and the additament, and the charge of them.

The *uses* will be for such things as are now made of

brass, and might be as well served by the compound stuff; wherein the doubts will be chiefly of the toughness and of the beauty.

First; therefore, if brass ordnance could be made of the compound stuff, in respect of the cheapness of the iron, it would be of great use.

The vantage which brass ordnance hath over iron, is chiefly, as I suppose, because it will hold the blow, though it be driven far thinner than the iron can be; whereby it saveth both in the quantity of the material, and in the charge and commodity of mounting and carriage, in regard by reason of the thinness it beareth much less weight: there may be also somewhat in being not so easily overheated.

Secondly; For the beauty; those things wherein the beauty or lustre are esteemed, are andirons, and all manner of images, and statues, and columns, and tombs, and the like. So as the *doubt* will be *double* for the beauty; the *one*, whether the colour will please so well, because it will not be so like gold as brass? the *other*, whether it will polish so well? Wherein for the latter it is probable it will; for steel glosses are more resplendent than the like plates of brass would be; and so is the glittering of a blade. And besides, I take it, andiron brass, which they call white brass, hath some mixture of tin to help the lustre. And for the golden colour, it may be by some small mixture of orpiment, such as they use to brass in the yellow alchemy, it will easily recover that which the iron loseth. Of this the eye must be the judge upon proof made.

But now for pans, pots, curfews, counters, and the like; the beauty will not be so much respected, so as the compound stuff is like to pass.

For the better use of the compound stuff, it v sweeter and cleaner than brass alone, which yiel smell or soiliness, and therefore may be better f vessels of the kitchen and brewing. It will a harder than brass, where hardness may be req

For the trial, the *doubts* will be *two : First*, the weight of brass towards iron, which will make iro on the top in the melting. This perhaps will be with the *calaminar stone*, which consenteth so wel brass, and, as I take it, is lighter than iron. Th *doubt* will be the stiffness and dryness of iron to which must be holpen either by *moistening* the i opening it. *For the first*, perhaps some mixture c will help; which is as much more liquid than br iron is less liquid. The *opening* may be holpen b mixture of sulphur: so as the trials would b brass, iron, *calaminar stone*, and sulphur; an again with the same composition, and an addit some lead; and in all this the charge must b sidered, whether it eat not out the profit of the ness of iron.

There be *two proofs* to be made of *incorpora metals for magnificence and delicacy*. The *one* f *eye*, and the *other* for the *ear*. Statua metal, an metal, and trumpet metal, and string metal; these, though the mixture of brass or copper sho dearer than the brass itself, yet the pleasure w vance the price to profit.

First therefore, for *statua-metal*, see *Pliny's* ures, which are almost forgotten, and consid charge.

Try likewise the mixture of tin in large pro

with copper, and observe the colour and beauty, it being polished. But chiefly let proof be made of the incorporating of copper or brass with glass-metal, for that is cheap, and is like to add a great glory and shining.

For *bell-metal*. *First*, it is to be known what is the composition which is now in use. *Secondly*, it is probable that it is the dryness of the metal that doth help the clearness of the sound, and the moistness that dulleth it; and therefore the mixtures that are probable, are steel, tin, glass-metal.

For *string-metal*, or *trumpet-metal*, it is the same reason; save that glass-metal may not be used, because it will make it too brittle; and trial may be made with mixture of silver, it being but a delicacy, with iron or brass.

To make proof of the incorporation of silver and tin in equal quantity, or with two parts silver and one part tin, and to observe whether it be of equal beauty and lustre with pure silver; and also whether it yield no soiliness more than silver? And again, whether it will endure the ordinary fire, which belongeth to chafing-dishes, posnets, and such other silver vessels? And if it do not endure the fire, yet whether by some mixture of iron it may not be made more fixt? For if it be in beauty and all the uses aforesaid equal to silver, it were a thing of singular profit to the state, and to all particular persons, to change silver plate or vessel into the compound stuff, being a kind of silver *electre*, and to turn the rest into coin. It may be also questioned, whether the compound stuff will receive gilding as well as silver, and with equal lustre? It is to be noted, that

the common allay of silver coin is brass, which doth discolour more, and is not so neat as tin.

The drownings of metals within other metals, in such sort as they can never rise again, is a thing of great profit. For if a quantity of silver can be so buried in gold, as it will never be reduced again, neither by fire, nor parting waters, nor otherways: and also that it serve all uses as well as pure gold, it is in effect all one as if so much silver were turned into gold; only the weight will discover it; yet that taketh off but half of the profit; for gold is not fully double weight to silver, but gold is twelve times price to silver.

The burial must be by one of these two ways, either by the smallness of the proportion, as perhaps fifty to one, which will be but six-pence gains in fifty shillings; or it must be holpen by somewhat which may fix the silver, never to be restored or vapoured away, when it is incorporated into such a mass of gold; for the less quantity is ever the harder to sever: and for this purpose iron is the likest, or coppel stuff, upon which the fire hath no power of consumption.

The making of gold seemeth a thing scarcely possible; because gold is the heaviest of metals, and to add matter is impossible: and again, to drive metals into a narrower room than their natural extent beareth, is a condensation hardly to be expected. But to make silver seemeth more easy, because both quicksilver and lead are weightier than silver; so as there needeth only fixing, and not condensing. The degree unto this that is already known, is infusing of quicksilver in a parchment, or otherwise, in the midst of molten lead

when it cooleth; for this stupifieth the quicksilver that it runneth no more. This trial is to be advanced three ways. *First*, by iterating the melting of the lead, to see whether it will not make the quicksilver harder and harder. *Secondly*, to put *realgar* hot into the midst of the quicksilver, whereby it may be condensed as well from within as without. *Thirdly*, to try it in the midst of molten iron, or molten steel, which is a body more likely to fix the quicksilver than lead. It may be also tried, by incorporating powder of steel, or coppel dust, by pouncing into the quicksilver, and so to proceed to the stupifying.

Upon glass four things would be put in proof. The *first*, means to make the glass more crystalline. The *second*, to make it more strong for falls, and for fire, though it come not to the degree to be malleable. The *third*, to make it coloured by tinctures, comparable [to] or exceeding precious stones. The *fourth*, to make a compound body of glass and galletyle; that is, to have the colour milky like a *chalcedon*, being a stuff between a porcelane and a glass.

For the *first;* it is good first to know exactly the several materials whereof the glass in use is made; window glass, Normandy and Burgundy, ale-house glass, English drinking glass: and then thereupon to consider what the reason is of the coarseness or clearness; and from thence to rise to a consideration how to make some additaments to the coarser materials, to raise them to the whiteness and crystalline splendour of the finest.

For the *second;* we see pebbles, and some other stones, will cut as fine as crystal, which if they will

melt, may be a mixture for glass, and may m
more tough and more crystalline. Besides, w
metals will vitrify; and perhaps some portion
glass of metal vitrified, mixed in the pot of or
glass-metal, will make the whole mass more to

For the *third;* it were good to have of coloure
dow glass, such as is coloured in the pot, and r
colours ———[1]

* * * * *

It is to be known of what stuff *galletyle* is mad
how the colours in it are varied; and thereupon t
sider how to make the mixture of glass-metal and
whereof I have seen the example.

Enquire what be the stones that do easiliest
Of them take half a pound, and of iron a pound
half, and an ounce of brimstone, and see whethe
will incorporate, being whole, with a strong fir
not, try the same quantities calcined: and if the
incorporate, make a plate of them, and burnish
they do iron.

Take a pound and a half of brass, and half a
of iron; two ounces of the *calaminar* stone, an
and a half of brimstone, an ounce of lead; calcine
and see what body they make; and if they incor
make a plate of it burnished.

Take of copper an ounce and a half, of tin an
and melt them together, and make a plate of ther
nished.

Take of copper an ounce and a half, of tin an
of glass-metal half an ounce; stir them well
boiling, and if they incorporate, make a plate of
burnished.

[1] Here something is wanting in the copy. — *Note by Tenison*

Take of copper a pound and a half, tin four ounces, brass two ounces; make a plate of them burnished.

Take of silver two ounces, tin half an ounce; make a little say-cup of it, and burnish it.

To enquire of the materials of every of the kind of glasses coarser and finer, and of the proportions.

Take an equal quantity of glass-metal, of stone calcined, and bring a pattern.

Take an ounce of vitrified metal, and a pound of ordinary glass-metal, and see whether they will incorporate; and bring a pattern.

Bring examples of all coloured glasses, and learn the ingredients whereby they are coloured.

Enquire of the substance of *galletyle.*

ARTICLES

OF

QUESTIONS TOUCHING MINERALS;

WRITTEN ORIGINALLY IN ENGLISH BY THE LORD BACON, YET HITHERTO NOT PUBLISHED IN THAT LANGUAGE.

The Lord Bacon's Questions and Solutions concerning the compounding, incorporating, or union of metals or minerals; which subject is the first letter of his Lordship's Alphabet.

Q. WITH what metals gold will incorporate by simple colliquefaction, and with what not? And in what quantity it will incorporate; and what kind of body the compound makes?

A. Gold with silver, which was the ancient electrum.

Gold with quicksilver.
Gold with lead.
Gold with copper.
Gold with brass.
Gold with iron.
Gold with tin.

So likewise of silver.

Silver with quicksilver.
Silver with lead.
Silver with copper.
Silver with brass.
Silver with iron. (*Plinius Secund.* lib. 33. ix.: *Miscuit denario triumvir Antonius ferrum.*)
Silver with tin.

So likewise of quicksilver.

Quicksilver with lead. | Quicksilver with brass.
Quicksilver with copper. | Quicksilver with iron.
Quicksilver with tin.

So of lead.

Lead with copper. | Lead with iron. | Lead with brass.
Lead with tin. (*Plin.* 34. ix.)

So of copper.

Copper with brass. | Copper with iron. | Copper with tin.

So of brass.

Brass with iron. | Brass with tin.

So of iron.

Iron with tin.

What be the compound metals that are common and known? And what are the proportions of their mixtures? As,

Latten of brass, and the *calaminar* stone.

Pewter of tin and lead.

Bell-metal of &c. and the counterfeit plate, which they call *alchemy*.

The decomposites of three metals or more, are too long to enquire of, except there be some compositions of them already observed.

It is also to be observed, whether any two metals, which will not mingle of themselves, will mingle with the help of another; and what.

What compounds will be made of metal with stone and other fossils; as latten is made with brass and the *calaminar* stone; as all the metals incorporate with vitriol; all with iron powdered; all with flint, &c.

Some few of these would be enquired of, to disclose the nature of the rest.

Whether metals or other fossils will incorporate with molten glass, and what body it makes?

The quantity in the mixture would be well considered; for some small quantity perhaps will incorporate, as in the allays of gold and silver coin.

Upon the compound body, three things are chiefly to be observed; the colour; the fragility or pliantness; the volatility or fixation, compared with the simple bodies.

For present use or profit, this is the rule: consider the price of the two simple bodies; consider again the dignity of the one above the other in use; then see if you can make a compound that will save more in price than it will lose in dignity of the use.

As for example; consider the price of brass-ordnance; consider again the price of iron-ordnance, and then consider wherein the brass-ordnance doth excel the iron-ordnance in use; then if you can make a compound of brass and iron that will be near as good in use, and much cheaper in price, then there is profit both to the private and the commonwealth. So of gold and silver, the price is double of twelve: the dignity of gold above silver is not much, the splendour is alike, and more pleasing to some eyes, as in cloth of silver, silvered rapiers, &c. The main dignity is, that gold bears the fire, which silver doth not: but that is an excellency in nature, but it is nothing at all in use; for any

dignity in use I know none, but that silvering will sully and canker more than gilding; which if it might be corrected with a little mixture of gold, there is profit: and I do somewhat marvel that the latter ages have lost the ancient *electrum*, which was a mixture of silver with gold: whereof I conceive there may be much use, both in coin, plate, and gilding.

It is to be noted, that there is in the version of metals impossibility, or at least great difficulty, as in making of gold, silver, copper. On the other side, in the adulterating or counterfeiting of metals, there is deceit and villainy. But it should seem there is a middle way, and that is by new compounds, if the ways of incorporating were well known.

What incorporation or imbibition metals will receive from vegetables, without being dissolved in their substance: as when the armourers make their steel more tough and pliant, by aspersion of water or juice of herbs; when gold being grown somewhat churlish by recovering, is made more pliant by throwing in shreds of tanned leather, or any leather oiled.

Note; that in these and the like shews of imbibition, it were good to try by the weights whether the weight be increased or no; for if it be not, it is to be doubted that there is no imbibition of substance, but only that the application of that other body doth dispose and invite the metal to another posture of parts than of itself it would have taken.

After the incorporation of metals by simple colliquefaction, for the better discovery of the nature and consents and dissents of metals, it would be likewise tried by incorporating of their dissolutions, [What metals being dissolved in strong waters will incorporate well

together, and what not? Which is to be enquir ticularly, as it was in colliquefactions].[1]

There is to be observed in those dissolutions will not easily incorporate, what the effects are: bullition; the precipitation to the bottom; the tion towards the top; the suspension in the mids the like.

Note; that the dissents of the menstrual or waters may hinder the incorporation, as well as sents of the metals themselves; therefore wh *menstrua* are the same, and yet the incorporat loweth not, you may conclude the dissent is in t als; but where the *menstrua* are several, not so

Dr. Meverel's answers to the Lord Bacon's questions, ing the compounding, incorporating, or union o and minerals.

Gold will incorporate with silver in any proportion lib. xxxiii. cap. 4. "Omni auro inest argentum va dere; alibi dena, alibi nona, alibi octava parte — que quinta argenti portio invenitur, electrum vocatu body remains fixed, solid, and coloured, according to portion of the two metals.

Gold with quicksilver easily mixeth, but the pr imperfectly fixed; and so are all other metals inc with mercury.

Gold incorporates with lead in any proportion.

Gold incorporates with copper in any proportion, t mon allay.

Gold incorporates with brass in any proportion

[1] The words within brackets are not in the original as printed b But a passage to the same effect occurs in Rawley's Latin tran this piece, and I suppose that some one had inserted a translat passage (as necessary to complete the sense) in the margin of which Blackbourne used: for Blackbourne inserts them as a sepa graph.

what is said of copper is true of brass, in the union of other metals.

Gold will not incorporate with iron.

Gold incorporates with tin, the ancient allay, Isa. I. 25.

What was said of gold and quicksilver, may be said of quicksilver and the rest of metals.

Silver with lead in any proportion.

Silver incorporates with copper. Pliny mentions such a mixture for triumphales statuæ, lib. xxxiii. 9. "Miscentur argento, tertia pars æris Cyprii tenuissimi, quod coronarium vocant, et sulphuris vivi quantum argenti." The same is true of brass.

Silver incorporates not with iron. Wherefore I wonder at that which Pliny hath, lib. xxxiii. 9. "Miscuit denario triumvir Antonius ferrum." And what is said of this is true in the rest; for iron incorporateth with none of them.

Silver mixes with tin.

Lead incorporates with copper. Such a mixture was the pot-metal whereof Pliny speaks, lib. xxxiv. 9. "Ternis aut quaternis libris plumbi argentarii in centenas æris additis."

Lead incorporates with tin. The mixture of these two in equal proportions, is that which was anciently called "plumbum argentarium," Plin. lib. xxxiv. 17.

Copper incorporates with tin. Of such a mixture were the mirrors of the Romans. Plin. "Atque ut omnia de speculis peragantur hoc loco, optima apud majores erant Brundusina, stanno et ære mistis." Lib. lxxxiii. 9.

Compounded metals now in use.

1. Fine tin. The mixture is thus: pure tin a thousand pounds, temper fifty pounds, glass of tin three pounds.

2. Coarse pewter is made of fine tin and lead. Temper is thus made: the dross of pure tin, four pounds and a half; copper, half a pound.

3. Brass is made of copper and *calaminaris*.

4. Bell-metal. Copper, a thousand pounds; tin, fro hundred to two hundred pounds; brass, a hundred a pounds.

5. Pot metal, copper and lead.

6. White alchemy is made of pan-brass one pou arsenicum three ounces.

7. Red alchemy is made of copper and auripign

There be divers imperfect minerals, which will porate with the metals: being indeed metals inwar clothed with earths and stones: as pyritis, calaminar chalcyti, sory, vitriolum.

Metals incorporate not with glass, except they be into the form of glass.

Metals dissolved. The dissolution of gold and sil agree, so that in their mixture there is great ebullitio ness, and in the end a precipitation of a black po

The mixture of gold and mercury agree.

Gold agrees with iron. In a word, the dissolu mercury and iron agree with all the rest.

Silver and copper disagree, and so do silver a Silver and tin agree.

The second letter of the cross-row, touching the sep of metals and minerals.

SEPARATION is of three sorts; the *first*, is t arating of the pure metal from the ore or dross we call refining. The *second*, is the drawing on or mineral out of another, which we call extr The *third*, is the separating of any metal into h inal, or *materia prima*, or element, or call ther you will; which work we will call *principiati*

For refining, we are to enquire of it accor the several metals; as gold, silver, &c. Incider

are to enquire of the first stone or ore, or marcasite of metals severally, and what kind of bodies they are, and of the degrees of richness. Also we are to enquire of the means of separating, whether by fire, parting waters, or otherwise. Also for the manner of refining, you are to see how you can multiply the heat, or hasten the opening, and so save the charge in the fining.

The means of this in three manners; that is to say, in the blast of the fire; in the manner of the furnace, to multiply heat by union and reflexion; and by some additament, or medicines which will help the bodies to open them the sooner.

Note; the quickening of the blast, and the multiplying of the heat in the furnace, may be the same for all metals; but the additaments must be several, according to the nature of the metals. Note again, that if you think that [by] the multiplying of the additaments in the same proportion that you multiply the ore, the work will follow, you may be deceived: for quantity in the passive will add more resistance than the same quantity in the active will add force.

For extracting, you are to enquire what metals contain others, and likewise what not; as lead, silver; copper, silver, &c.

Note; although the charge of extraction should exceed the worth, yet that is not the matter. For at least it will discover nature and possibility, the other may be thought on afterwards.

We are likewise to enquire, what the differences are of those metals which contain more or less other metals, and how that agrees with the poorness or richness of the metals or ore in themselves. As the lead that con-

tains most silver is accounted to be more britt
yet otherwise poorer in itself.

For *principiation*, I cannot affirm whether th
any such thing or not; and I think the chemists
too much ado about it; but howsoever it be, be
tion, or extraction, or a kind of conversion by th
it is diligently to be enquired what salts, sulphu
riol, mercury, or the like simple bodies are to be
in the several metals, and in what quantity.

*Dr. Meverel's answers to the foregoing questions, t
the separations of metals and minerals.*

1. For the *means of separating*. After that the
washed, or cleansed from the earth, there is nothing
necessary, save only a wind furnace well framed,
above and at the hearth, in shape oval, sufficiently f
charcoal and ore, in convenient proportions.

For additions in this first separation, I have o
none; the dross the mineral brings being sufficient
refiners of iron observe, that that ironstone is ha
melt which is fullest of metal, and that easiest whi
most dross. But in lead and tin the contrary is
Yet in melting of metals, when they have been
formerly by fire, or strong waters, there is good us
ditaments, as of borax, tartar, armoniac, and salt-p

2. In *extracting of metals*. Note, that lead and
tain silver. Lead and silver contain gold. Iron
brass. Silver is best separated from lead by the te
gold from silver. Yet the best way for that is *aqu*

3. For *principiation*. I can truly and boldly affi
there are no such principles as sal, sulphur, and m
which can be separated from any perfect metals.
ery part so separated, may easily be reduced into
metal without substitution of that, or those principle
chemists imagine to be wanting. As suppose you t

salt of lead; this salt, or as some name it, sulphur, may be turned into perfect lead, by melting it with the like quantity of lead which contains principles only for itself.

I acknowledge that there is quicksilver and brimstone found in the imperfect minerals; but those are nature's remote materials, and not the chemist's principles. As if you dissolve antimony by *aqua regia*, there will be real brimstone swimming upon the water: as appears by the colour of the fire when it is burnt, and by the smell.

The third letter of the cross-row, touching the variation of metals into several shapes, bodies, or natures, the particulars whereof follow.

Tincture.	Opening or dissolving into liquor.
Turning to rust.	Sproutings, or branchings, or arborescents.
Calcination.	Induration and mollification.
Sublimation.	Making tough or brittle.
Precipitation.	Volatility and fixation.
Amalgamatizing, or turning into a soft body.	
Vitrification.	

Transmutation, or version.

For *tincture*; it is to be enquired how metal may be tinged through and through, and with what, and into what colours; as tinging silver yellow, tinging copper white, and tinging red, green, blue; especially with keeping the lustre.

Item, tincture of glasses.

Item, tincture of marble, flint, or other stone.

For *turning into rust*, two things are chiefly to be enquired; by what corrosives[1] it is done, and into what

[1] *corasives* in orig.

colours it turns; as lead into white, which the *cerus;* iron into yellow, which they call *crocus m* quicksilver into vermilion; brass into green, they call verdigrease.

For *calcination;* how every metal is calcined into what kind of body, and what is the exquisites of calcination.

For *sublimation;* to enquire the manner of subli and what metals endure subliming, and what boc sublimate makes.

For *precipitation* likewise; by what strong every metal will precipitate, and with what additar and in what time, and into what body.

So for *amalgama;* what metals will endure it, are the means to do it, and what is the manner body.

For *vitrification* likewise; what metals will endı what are the means to do it, into what colour it and further where the whole metal is turned into and where the metal doth but hang in the glassy also what weight the vitrified body bears, com with the crude body; also because vitrification counted a kind of death of metals, what vitrifi will admit of turning back again, and what no

For *dissolution* into liquor, we are to enquire w the proper *menstruum* to dissolve any metal, and negative, what will touch upon the one and not the other, and what several *menstrua* will dissolv metal, and which most exactly. *Item* the proc motion of the dissolution, the manner of rising, bc vapouring, more violent or more gentle, causing heat or less. *Item* the quantity or charge th strong water will bear, and then give over. *Ite*

colour into which the liquor will turn. Above all it is to be enquired, whether there be any *menstruum* to dissolve any metal, that is not fretting or corroding, and openeth the body by sympathy, and not by mordacity or violent penetration.

For *sprouting or branching*, though it be a thing but transitory, and a kind of toy or pleasure, yet there is a more serious use of it; for that it discovereth the delicate motions of spirits, when they put forth and cannot get forth, like unto that which is in vegetables.

For *induration*, or mollification; it is to be enquired what will make metals harder and harder, and what will make them softer and softer. And this inquiry tendeth to two ends: first, for use; as to make iron soft by the fire makes it malleable. Secondly, because induration is a degree towards fixation, and mollification towards volatility; and therefore the inquiry of them will give light towards the other.

For *tough and brittle*, they are much of the same kind but yet worthy of an inquiry apart, especially to join hardness with toughness, as making glass malleable, &c. and making blades strong to resist and pierce, and yet not easy to break.

For *volatility and fixation*. It is a principal branch to be enquired: the utmost degree of fixation is that whereon no fire will work, nor strong water joined with fire, if there be any such fixation possible. The next is, when fire simply will not work without strong waters. The next is by the test. The next is when it will endure fire not blown, or such a strength of fire. The next is when it will not endure, but yet is malleable. The next is when it is not malleable, but yet is not fluent, but stupified. So of volatility, the ut-

most degree is when it will fly away without ing. The next is when it will fly up, but wi return. The next is when it will fly upwards o helm [1] by a kind of exsufflation without vaj The next is when it will melt though not rise next is when it will soften though not melt. these diligent inquiry is to be made in several especially of the more extreme degrees.

For *transmutation* or version. If it be real a it is the farthest part of art, and would be well guished from extraction, from restitution, and fro teration. I hear much of turning iron into co hear also of the growth of lead in weight, whi not be without a conversion of some body int but whatsoever is of this kind, and well expr diligently to be enquired and set down.

Dr. Meverel's answers to the foregoing questions, co the variation of metals and minerals.

1. For *tinctures*, there are none that I know, rich variety which springs from mixture of metals w als, or imperfect minerals.

2. The imperfect metals are subject to *rust*, all except mercury, which is made into vermilion by sol calcination. The rest are rusted by any salt, sour, water. Lead into a white body called *cerussa*. Iro pale red called *ferrugo*. Copper is turned into green *ærugo, æs viride*. Tin into white: but this is not neither hath it obtained a name.

The Scriptures mention the rust of gold, but that gard of the allay.

3. *Calcination*. All metals may be calcined b waters, or by admixtion of salt, sulphur, and mercur

[1] So orig. Rawley translates it *supra caput*; and it is proba take for *head*.

imperfect metals may be calcined by continuance of simple fire; iron thus calcined is called *crocus martis.*

And this is their best way. Gold and silver are best calcined by mercury. Their colour is grey. Lead calcined is very red. Copper dusky red.

4. Metals are *sublimed* by joining them with mercury or salts. As silver with mercury, gold with sal armoniac, mercury with vitriol.

5. *Precipitation* is, when any metal being dissolved into a strong water, is beaten down into a powder by salt water. The chiefest in this kind is oil of tartar.

6. *Amalgamation* is the joining or mixing of mercury with any other of the metals. The manner is this in gold, the rest are answerable: take six parts of mercury, make them hot in a crucible, and pour them to one part of gold made red-hot in another crucible, stir these well together that they may incorporate; which done, cast the mass into cold water and wash it. This is called the amalgama of gold.

7. For *vitrification.* All the imperfect metals may be turned by strong fire into glass, except mercury; iron into green; lead into yellow; brass into blue; tin into pale yellow. For gold and silver, I have not known them vitrified, except joined with antimony. These glassy bodies may be reduced into the form of mineral bodies.

8. *Dissolution.* All metals without exception may be dissolved.

(1.) Iron may be dissolved by any tart, salt, or vitriolated water; yea, by common water, if it be first calcined with sulphur. It dissolves in *aqua forti*, with great ebullition and heat, into a red liquor, so red as blood.

(2.) Lead is fittest dissolved in vinegar, into a pale yellow, making the vinegar very sweet.

(3.) Tin is best dissolved with distilled salt water. It retains the colour of the *menstruum.*

(4.) Copper dissolves as iron doth, in the same liquor, into a blue.

(5.) Silver hath its proper *menstruum*, which is *aqu tis*. The colour is green, with great heat and ebullitio

(6.) Gold is dissolved with *aqua regia*, into a yello uor, with little heat or ebullition.

(7.) Mercury is dissolved with much heat and boilin the same liquors which gold and silver are. It alters n colour of the *menstruum*.

Note. Strong waters may be charged with half weight of fixed metals, and equal of mercury; if the man be skilful.

9. *Sprouting.* This is an accident of dissolution. the *menstruum* be overcharged, then within short tin metals will shoot into certain crystals.

10. For *induration*, or *mollification*, they depend up quantity of fixed mercury and sulphur. I have ob little of them, neither of toughness nor brittleness.

11. The *degrees of fixation* and *volatility* I ackno except the two utmost, which never were observed.

12. The question of *transmutation* is very do Wherefore I refer your honour to the fourth tome of *trum Chymicum:* and there, to that tract which is i *Disquisitio Heliana;* where you shall find full satisf

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The fourth letter of the cross-row, touching restitut

First, therefore it is to be enquired in the neg what bodies will never return, either by their ex fixings, as in some vitrifications, or by extreme vola

It is also to be enquired of the two means of r tion; and first by the fire, which is but by congre of homogeneal parts.

The second is, by drawing them down by some that hath consent with them. As iron draweth copper in water; gold draweth quicksilver in va

whatsoever is of this kind, is very diligently to be enquired.

Also it is to be enquired what time or age will reduce without help of fire or body.

Also it is to be enquired what gives impediment to union or restitution, which is sometimes called mortification; as when quicksilver is mortified with turpentine, spittle, or butter.

Lastly, it is to be enquired how the metal restored differeth in any thing from the metal rare:[1] as whether it become not more churlish, altered in colour, or the like.

Dr. Meverel's answers touching the restitutions of metals and minerals.

Reduction is chiefly effected by fire, wherein if they stand and nele, the imperfect metals vapour away, and so do all manner of salts which separated them *in minimas partes* before.

Reduction is singularly holpen by joining store of metal of the same nature with it in the melting.

Metals reduced are somewhat churlish, but not altered in colour.

[1] So orig. The translation has *crudo*.

THE LORD VERULAM'S INQUISITION CONCERNI VERSIONS, TRANSMUTATIONS, MULTIPLICATI AND EFFECTIONS OF BODIES,

Written by him originally in English, though not published in that language.[1]

EARTH by fire is turned into brick, which i nature of a stone, and serveth for building, doth: and the like of tile. *Qu. the manner.*

Naphtha, which was the bituminous mortar the walls of Babylon, grows to an entire and ve matter like a stone.

In clay countries, where there is pebble and you shall find great stones, where you may see bles or gravel, and between them a substance as hard or harder than the pebble itself.

There are some springs of water, wherein if wood, it will turn into the nature of stone: s within the water shall be stone, and that ab water continue wood.

The slime about the reins and bladder in man turns into stone: and stone is likewise found the gall; and sometimes, though rarely, in *vent*

Quære, what time the substance of earth in asketh to be turned into stone?

Water, as it seems, turneth into crystal, as i divers caves, where the crystal hangs *in stillicid*

Try wood, or the stalk of herbs, buried in ver, whether it will not grow hard and stony.

They speak of a stone engendered in a toad'

There was a gentleman, digging in his moa

[1] Baconiana, p. 129.

an egg turned into stone, the white and the yolk keeping their colour, and the shell glistering like a stone cut with corners.

Try some things put into the bottom of a well; as wood, or some soft substance: but let it not touch the water, because it may not putrify.

They speak, that the white of an egg with lying long in the sun, will turn stone.

Mud in water turns into shells of fishes, as in horse-mussels, in fresh ponds, old and overgrown. And the substance is a wondrous fine substance, light and shining.

CERTAIN EXPERIMENTS MADE BY THE LORD BACON ABOUT WEIGHT IN AIR AND WATER.[1]

A NEW sovereign of equal weight in the air to the piece in brass, overweigheth in the water nine grains:

[1] Baconiana, p. 134.

Bacon derived this method of weighing in air and water from Porta, who in his *Natural Magic* speaks of it as so great a thing as to entitle him to say *ὑπερεύρηκα ὑπερεύρηκα*; referring of course to the story of Archimedes. Of course it is possible to calculate specific gravities from experiments in which both scales of the balance are immersed in water; but Porta's rule for determining the amount of alloy contained in a piece of gold is altogether wrong, and how confused his notions were is shown by his directing the experimenter to immerse the scales *circiter semipedem*, as if the depth made any difference. So too Bacon speaks of immersing one of the scales five inches. Porta, a little further on, records some experiments made by immersing only one of the scales; and so we may observe does Bacon, — a circumstance which makes it plain that he was following Porta's directions. The notion of weighing in air and water was however not new. It is treated of at some length by Nicholas De Cusa. But Cusa's notions are at least as confused as Porta's. Thus he wants to determine not only the *pondus gravitatis*, but other kinds of *pondera*; and remarking that lead comes next to gold in *pondus gravitatis* — so that it would seem as if the comparative value of metals could not be determined by the balance — goes on to say that if we take account of the *pondus ignis*, then silver would, as

in three sovereigns the difference in the water twenty-four grains.

The same sovereign overweigheth an equal of lead, four grains in the water, in brass gra gold: in three sovereigns about eleven grains.

The same sovereign overweigheth an equal of stones in the air, at least sixty-five grains water: the grains being for the weight of gold metal.

A glass filled with water weighing, in Troy thirteen ounces and five drams, the glass and th together, weigheth severally, viz. the water nine and a half, and the glass four ounces and a dra

A bladder weighing two ounces seven dram half, a pebble laid upon the top of the bladde three ounces six drams and a half, the stone w seven drams.

The bladder (as above) blown, and the sam weigheth equal.

it ought to do, come next. See Porta's *Natural Magic*, 18. ch Cusa *de Staticis Experimentis*, appended to the edition of Vitr lished at Strasbourg, 1550. (The tract is not paged.)

One of the first determinations of specific gravity results from statement with respect to Mercury. He says "quum sint quatuo rum mensuræ cum expenduntur invenientur esse pondo centu the *congius* held, as we know, ten Roman pounds of water, an the *sextarius* held five-thirds of a pound; four *sextarii* conse water would weigh six pounds and two-thirds; and comparing Vitruvius's statement, the specific gravity of quicksilver is fifte sult sufficiently near the truth, but erring in excess.

It is worth remarking that Vitruvius in the passage I refer t name of minium to cinnabar, not as commonly to red-lead. Th vermillion must originally have belonged, as the etymology ir kermes or cochineal. There is however a great deal of confusi names; and it would seem from Arrian that the name cinnabar nally given to cochineal. There is a wonderful story of its bein by a mixture of the blood of dragons and of elephants. See book vii. chap. 8. — *R. L. E.*

A sponge dry weigheth one ounce twenty-six grains: the same sponge being wet, weigheth fourteen ounces six drams and three quarters: the water weigheth in several eleven ounces one dram and a half, and the sponge three ounces and a half and three quarters of a dram. *First time.*

The sponge and water together weigh fifteen ounces and seven drams: in several, the water weigheth eleven ounces and even drams, and the sponge three ounces seven drams and a half. *Second time.*

Three sovereigns made equal to a weight in silver in the air differ in the water.

For false weights, one beam long, the other thick.

The stick and thread weigh half a dram and twenty grains, being laid in the balance.

The stick tied to reach within half an inch of the end of the beam, and so much from the tongue, weigheth twenty-eight grains; the difference is twenty-two grains.

The same stick being tied to hang over the end of the beam an inch and a half, weigheth half a dram and twenty-four grains; exceeding the weight of the said stick in the balance by four grains.

The same stick being hanged down beneath the thread, as near the tongue as is possible, weigheth only eight grains.

Two weights of gold being made equal in the air, and weighing severally seven drams; the one balance being put into the water, and the other hanging in the air, the balance in the water weigheth only five drams and three grains, and abateth of the weight in the air, one dram and a half, and twenty-seven grains.

The same trial being made the second time, and more

truly and exactly betwixt gold and gold, weigl erally (as above) and making a just and equa in the air, the one balance being put into the v depth of five inches, and the other hanging ir the balance in the water weigheth only four dı fifty-five grains, and abateth of the weight in two drams and five grains.

The trial being made betwixt lead and leac ing severally seven drams in the air, the balan water weigheth only four drams and forty-on and abateth of the weight in the air two dr nineteen grains; the balance kept the same the water as abovesaid.

The trial being made betwixt silver and weighing severally seven drams in the air, the in the water weigheth only four drams and tw grains. So it abateth two drams and thirty-five the same depth in the water observed.

In iron and iron, weighing severally each b the air seven drams, the balance in the water only four drams and eighteen grains; and ab the weight in the air two drams and forty-two the depth observe as above.

In stone and stone, the same weight of seve equally in the air, the balance in the water only two drams and twenty-two grains; and of the weight in the air four drams and thi grains; the depth as above.

In brass and brass, the same weight of seve in each balance, equal in the air, the balanc water weigheth only four drams and twenty-tw and abateth in the water two drams and thi grains; the depth observed.

The two balances being weighed in air and water, the balance in the air over-weigheth the other in the water one dram and twenty-eight grains; the depth in the water as aforesaid.

It is a profitable experiment which sheweth the weights of several bodies in comparison with water. It is of use in lading of ships and other bottoms, and may help to shew what burden in the several kinds they will bear.

CERTAIN SUDDEN THOUGHTS OF THE LORD BACON'S, SET DOWN BY HIM UNDER THE TITLE OF EXPERIMENTS FOR PROFIT.[1]

Muck of leaves.

Muck of river, earth, and chalk.

Muck of earth closed, both for salt-petre and muck.

Setting of wheat and peas.

Mending of crops by steeping of seeds.

Making peas, cherries, and strawberries come early.

Strengthening of earth for often returns of radishes, parsnips, turnips, &c.

Making great roots of onions, radishes, and other esculent roots.

Sowing of seeds of trefoil.

Setting of woad.

Setting of tobacco, and taking away the rawns.

Grafting upon boughs of old trees.

Making of a hasty coppice.

Planting of osiers in wet grounds.

Making of candles to last long.

[1] Baconiana, p. 138.

Building of chimnies, furnaces, and ovens, to give heat with less wood.

Fixing of logwood.

Other means to make yellow and green fixed.

Conserving of oranges, lemons, citrons, pomegranates, &c. all summer.

Recovering of pearl, coral, turchoise colour, by a conservatory of snow.

Sowing of fennel.

Brewing with hay, haws, trefoil, broom, heps, bramble-berries, woodbines, wild thyme, instead of hops, thistles.

Multiplying and dressing artichokes.

CERTAIN EXPERIMENTS OF THE LORD BACON'S, ABOUT THE COMMIXTURE OF LIQUORS ONLY, NOT SOLIDS, WITHOUT HEAT OR AGITATION, BUT ONLY BY SIMPLE COMPOSITION AND SETTLING.[1]

Spirit of wine mingled with common water, although it be much lighter than oil, yet so as if the first fall be broken by means of a sop or otherwise, it stayeth above; and if it be once mingled, it severeth not again, as oil doth. Tried with water coloured with saffron.

Spirit of wine mingled with common water hath a kind of clouding, and motion shewing no ready commixture. Tried with saffron.

A dram of gold dissolved in *aqua regis*, with a dram of copper in *aqua forti*, commixed, gave a green colour, but no visible motion in the parts. Note, that the dissolution of the gold was twelve parts water to one part body: and of the copper was six parts water to one part body.

[1] Baconiana, p. 140.

Oil of almonds commixed with spirit of wine severeth, and the spirit of wine remaineth on the top, and the oil in the bottom.

Gold dissolved, commixed with spirit of wine, a dram of each, doth commix, and no other apparent alteration.

Quicksilver dissolved with gold dissolved, a dram of each, doth turn to a mouldy liquor, black, and like smiths' water.

Note, the dissolution of the gold was twelve parts water, *ut suprà*, and one part metal: that of water was two parts, and one part metal.

Spirit of wine and quicksilver commixed, a dram of each, at the first shewed a white milky substance at the top, but soon after mingled.

Oil of vitriol commixed with oil of cloves, a dram of each, turneth into a red dark colour; and a substance thick, almost like pitch; and upon the first motion gathereth an extreme heat, not to be endured by touch.

Dissolution of gold, and oil of vitriol commixed, a dram of each, gathereth a great heat at the first, and darkeneth the gold, and maketh a thick yellow.

Spirit of wine and oil of vitriol, a dram of each, hardly mingle; the oil of vitriol going to the bottom, and the spirit of wine lying above in a milky substance. It gathereth also a great heat, and a sweetness in the taste.

Oil of vitriol and dissolution of quicksilver, a dram of each, maketh an extreme strife, and casteth up a very gross fume, and after casteth down a white kind of curds, or sands; and on the top a slimish substance, and gathereth a great heat.

Oil of sulphur and oil of cloves commixed, a dram of each, turn into a thick and red-coloured substance; but no such heat as appeared in the commixture with the oil of vitriol.

Oil of petroleum and spirit of wine, a dram of each, intermingle otherwise than by agitation, as wine and water do; and the petroleum remaineth on the top.

Oil of vitriol and petroleum, a dram of each, turn into a mouldy substance, and gathereth some warmth; there residing a black cloud in the bottom, and a monstrous thick oil on the top.

Spirit of wine and red-wine vinegar, one ounce of each, at the first fall one of them remaineth above, but by agitation they mingle.

Oil of vitriol and oil of almonds, one ounce of each, mingle not; but the oil of almonds remaineth above.

Spirit of wine and vinegar, an ounce of each, commixed, do mingle, without any apparent separation, which might be in respect of the colour.

Dissolution of iron, and oil of vitriol, a dram of each, do first put a milky substance into the bottom, and after incorporate into a mouldy substance.

Spirit of wine commixed with milk, a third part spirit of wine, and two parts milk, coagulateth little, but mingleth; and the spirit swims not above.

Milk and oil of almonds mingled, in equal portions, do hardly incorporate, but the oil cometh above, the milk being poured in last; and the milk appeareth in some drops or bubbles.

Milk one ounce, oil of vitriol a scruple, doth coagulate; the milk at the bottom where the vitriol goeth.

Dissolution of gum tragacanth, and oil of sweet almonds, do not commingle, the oil remaining on the top

till they be stirred, and make the mucilage[1] somewhat more liquid.

Dissolution of gum tragacanth one ounce and a half, with half an ounce of spirit of wine, being commixed by agitation, make the mucilage[1] more thick.

The white of an egg with spirit of wine, doth bake the egg into clots, as if it began to poch.

One ounce of blood, one ounce of milk, do easily incorporate.

Spirit of wine doth curdle the blood.

One ounce of whey unclarified, one ounce of oil of vitriol, make no apparent alteration.

One ounce of blood, one ounce of oil of almonds, incorporate not, but the oil swims above.

Three quarters of an ounce of wax being dissolved upon the fire, and one ounce of oil of almonds put together and stirred, do not so incorporate, but that when it is cold the wax gathereth and swims upon the top of the oil.

One ounce of oil of almonds cast into an ounce of sugar seething, sever presently, the sugar shooting towards the bottom.

A CATALOGUE OF BODIES ATTRACTIVE AND NOT ATTRACTIVE MADE BY THE LORD BACON, TOGETHER WITH EXPERIMENTAL OBSERVATIONS ABOUT ATTRACTION.[2]

THESE following bodies *draw:*

Amber, jet, diamond, sapphire, carbuncle, iris, the gem. opale, amethyst, bristollina, crystal, clear glass,

[1] *muselates* in the original.

[2] Baconiana, p. 145.

glass of antimony, divers flowers from mines, sulphur, mastic, hard sealing-wax, the harder rosin, arsenic.

These following bodies *do not draw:*

Smaragd, achates, corneolus, pearl, jaspis, chalcedonius, alabaster, porphyry, coral, marble, touchstone, hæmatites or bloodstone, smyris, ivory, bones, ebon-tree, cedar, cypress, pitch, softer rosin, camphire, galbanum, ammoniac, storax, benjoin, loadstone,[1] asphaltum.

These bodies, gold, silver, brass, iron, draw not, though never so finely polished.

In *winter*, if the air be sharp and clear, *sal gemmeum*, *rock alum*, and *lapis specularis*, will draw.

These following bodies are apt *to be drawn*, if the mass of them be small:

Chaff, woods, leaves, stones, all metals leaved, and in the mine; earth, water, oil.

Si fiat versorium ex metallo aliquo more Indicis Magnetici, et fini alteri apponatur succinum, leniter fricatum, versorium convertit se.

Succinum calefactum ab igne, sive tepeat, sive ferveat, sive inflammetur, non trahit.

Bacillum ferreum candens, flamma, candela ardens, carbo ignitus, admota festucis aut versoriis, non trahunt.

Succinum in majore mole, si fuerit politum, allicit, licet non fricatum; si in minore, aut impurius, sine frictione non trahit.

Crystallus, lapis specularis, vitrum, electrica cetera, si urantur, aut torreantur, non trahunt.

[1] A note in the margin says *the drawing of iron excepted.*

Pix.
Resina mollior.
Benjoin.
Asphaltum.
Camphora.
Galbanum.
Ammoniacum.
Storax.
Assa.

} Hæc cœlo calidiore neutiquam prorsus trahunt; at tempore frigidiore obscure et inferme trahunt.

Vapidus aër succino, &c. afflatus, vel ab ore, vel ab aëre humidiore, virtutem trahendi suffocat.

Si charta aut linteum interponatur inter succinum et paleam, non fit motus aut attractio.

Succinum aut electrica calefacta ex radiis solis, non expergefiunt ad trahendum, sicut ex frictione.

Succinum fricatum, et radiis solis expositum, diutius vires trahendi retinet, nec tam cito eas deponit ac si in umbra positum esset.

Fervor ex speculo comburente succino, &c. conciliatus, non juvat ad trahendum.

Sulphur accensum, et cera dura inflammata, non trahunt.

Succinum, cum citissime a frictione festucæ vel versorio apponitur, optime trahit.

Virtus electrica viget in retentione ad tempus non minus quam in attractione prima.

Flamma apposito succino intra orbem activitatis non trahitur.

Gutta aquæ admoto succino trahitur in conum. Electrica si durius affricentur, impeditur attractio.

Quæ ægre alliciunt in claro cœlo, in crasso non movent.

Aqua imposita succino virtutem trahendi suffocat, licet ipsam aquam trahat.

Sarca ita succino circundatum, ut tangat, attractionem tollit; sed interpositum ut non tangat, non omnino tollit.

Oleum succino appositum motum non impedit; nec succinum digito oleo madefacto fricatum, vires trahendi perdit.

Firmius provocant, et diutius retinent succinum, gagates, et hujusmodi, etiam minore cum frictione: adamas, crystallum, vitrum, diutius teri debent, ut manifesto incalescant antequam trahant.

Quæ flammæ approximant, licet propinqua distantia, a succino non trahuntur.

Fumum extincta lucerna succinum, &c. trahit. Fumus ubi exit et crassus est, fortius trahit succinum; cum ascenderit, et rarior fit, debilius. Corpus ab electricis attractum non manifesto alteratur, sed tantum incumbit.

MEDICAL REMAINS.

A Medical Paper of the Lord Bacon's, to which he gave the title of Grains of Youth.[1]

TAKE of nitre four grains, of ambergrease three grains, of orris-powder two grains, of white poppy-seed the fourth part of a grain, of saffron half a grain, with water of orange-flowers, and a little tragacanth; make them into small grains, four in number. To be taken at four a-clock, or going to bed.

Preserving ointments.

Take of deers-suet one ounce, of myrrh six grains, of saffron five grains, of bay-salt twelve grains, of Canary wine, of two years old, a spoonful and a half. Spread it on the inside of your shirt, and let it dry, and then put it on.

A purge familiar for opening the liver.

Take rhubarb two drams, agaric trochiscat one dram and a half, steep them in claret wine burnt with mace; take of wormwood one dram, steep it with the rest, and make a mass of pills with *syrup. acetos.* simplex. But drink an opening broth before it, with succory, fennel, and smallage roots, and a little of an onion.

[1] Baconiana, p. 155.

Wine for the spirits.

Take gold perfectly refined three ounces, quench it six or seven times in good claret wine; add of nitre six grains for two draughts; add of saffron prepared three grains, of ambergrease four grains, pass it through an hippocras bag, wherein there is a dram of cinnamon gross beaten, or, to avoid the dimming of the colour, of ginger. Take two spoonsful of this to a draught of fresh claret wine.

The preparing of saffron.

Take six grains of saffron, steeped in half parts of wine and rose water, and a quarter part vinegar: then dry it in the sun.

Wine against adverse melancholy, preserving the senses and the reason.

Take the roots of bugloss well scraped, and cleansed from their inner pith, and cut them into small slices; steep them in wine of gold extinguished *ut suprà*, and add of nitre three grains, and drink it *ut suprà*, mixed with fresh wine: the roots must not continue steeped above a quarter of an hour; and they must be changed thrice.

Breakfast-preservative against the gout and rheums.

To take once in the month at least, and for two days together, one grain of *castorei* in my ordinary broth.

The preparation of garlick.

Take garlick four ounces, boil it upon a soft fire in claret wine, for half an hour. Take it out and steep it

in vinegar; whereto add two drams of cloves, then take it forth, and keep it in a glass for use.

The artificial preparation of damask-roses, for smell.

Take roses, pull their leaves, then dry them in a clear day in the hot sun: then their smell will be as gone. Then cram them into an earthen bottle, very dry and sweet, and stop it very close; they will remain in smell and colour both, fresher than those that are otherwise dried. Note, the first drying, and close keeping upon it, preventeth all putrefaction, and the second spirit cometh forth, made of the remaining moisture not dissipated.

A restorative drink.

Take of Indian maiz half a pound, grind it not too small, but to the fineness of ordinary meal, and then bolt and serce it, that all the husky part may be taken away. Take of eryngium roots three ounces, of dates as much, of enula two drams, of mace three drams, and brew them with ten-shilling beer to the quantity of four gallons: and this do, either by decocting them in a pottle of wort, to be after mingled with the beer, being new tapped, or otherwise infuse it in the new beer in a bag. Use this familiarly at meals.

Against the waste of the body by heat.

Take sweet pomegranates, and strain them lightly, not pressing the kernel, into a glass; where put some little of the peel of a citron, and two or three cloves, and three grains of ambergrease, and a pretty deal of fine sugar. It is to be drunk every morning whilst pomegranates last.

Methusalem Water. Against all asperity and torrefaction of inward parts, and all adustion of the blood, and generally against the dryness of age.

Take crevises very new, *q. s.* boil them well in claret wine, of them take only the shells, and rub them very clean, especially on the inside, that they may be thoroughly cleansed from the meat. Then wash them three or four times in fresh claret wine, heated; still changing the wine, till all the fish-taste be quite taken away. But in the wine wherein they are washed, steep some tops of green rosemary; then dry the pure shell thoroughly, and bring them to an exquisite powder. Of this powder take three drams. Take also pearl, and steep them in vinegar twelve hours, and dry off the vinegar; of this powder also three drams. Then put the shell powder and pearl powder together, and add to them of ginger one scruple, and of white poppy-seed half a scruple, and steep them in spirit of wine (wherein six grains of saffron have been dissolved) seven hours. Then upon a gentle heat vapour away all the spirit of wine, and dry the powder against the sun without fire. Add to it of nitre one dram, of amber-grease one scruple and a half; and so keep this powder for use in a clean glass. Then take a pottle of milk, and slice in it of fresh cucumbers, the inner pith only (the rind being pared off), four ounces, and draw forth a water by distillation. Take of claret wine a pint, and quench gold in it four times.

Of the wine, and of the water of milk, take of each three ounces, of the powder one scruple, and drink it in the morning; stir up the powder when you drink, and walk upon it.

A CATALOGUE OF ASTRINGENTS, OPENERS, AND CORDIALS, INSTRUMENTAL TO HEALTH.

Collected by Sir Francis Bacon, Baron of Verulam.[1]

ASTRINGENTS.

RED rose, black-berry, myrtle, plantane, flower of pomegranate, mint, aloes well washed, myrobalanes, sloes, agresta, fraga, mastich, myrrh, saffron, leaves of rosemary, rhubarb received by infusion, cloves, service-berries, corna, wormwood, bole armeniac, sealed earth, cinquefoil, tincture of steel, sanguis draconis, coral, amber, quinces, spikenard, galls, alum, blood-stone, mummy, amomum, galangal, cypress, ivy, psyllum, house-leek, sallow, mullein, vine, oak-leaves, lign-aloës, red sanders, mulberry, medlars, flowers of peach-trees, pomegranates, pears, palmule, pith of kernels, purslain, acacia, laudanum, tragacanth, thus olibani, comfrey, shepherds-purse, polygonium.

Astringents (both hot and cold) which corroborate the parts, and which confirm and refresh such of them as are loose or languishing.

Rosemary, mint, especially with vinegar, cloves, cinnamon, cardamom, lign-aloes, rose, myrtle, red sanders, cotonea, red wine, chalybeat-wine, five-finger grass, plantane, apples of cypress, berberries, fraga, service-berries, cornels, ribes, sour pears, rambesia.

Astringents styptic, which by their styptic virtue may stay fluxes.

Sloes, acacia, rind of pomegranates infused, at least

[1] Baconiana, p. 161.

three hours, the styptic virtue not coming forth in lesser time. Alum, galls, juice of sallow, syrup of unripe quinces, balaustia, the whites of eggs boiled hard in vinegar.

Astringents which by their cold and earthy nature may stay the motion of the humours tending to a flux.

Sealed earth, sanguis draconis, coral, pearls, the shell of the fish dactylus.

Astringents which by the thickness of their substance stuff as it were the thin humours, and thereby stay fluxes.

Rice, beans, millet, cauls, dry cheese, fresh goats-milk.

Astringents which by virtue of their glutinous substance restrain a flux, and strengthen the looser parts.

Karabe,[1] mastich, spodium, hartshorn, frankincense, dried bull's pistle, gum tragacanth.

Astringents purgative, which, having by their purgative or expulsive power thrust out the humours, leave behind them astrictive virtue.

Rhubarb, especially that which is toasted against the fire: myrobalanes, tartar, tamarinds, [an Indian fruit like green damasens.] [2]

Astringents which do very much suck and dry up the humours, and thereby stay fluxes.

Rust of iron, crocus martis, ashes of spices.

[1] Perhaps he meant the fruit of Karobe. — *Note by Tenison.*

[2] So bracketed in the original.

Astringents which by their nature do dull the spirits, and lay asleep the expulsive virtue, and take away the acrimony of all humours.

Laudanum, mithridate, diascordium, diacodium.

Astringents which, by cherishing the strength of the parts, do comfort and confirm their retentive power.

A stomacher of scarlet cloth. Whelps, or young healthy boys, applied to the stomach. Hippocratic wines, so they be made of austere materials.

OPENERS.

Succory, endive, betony, liverwort, petroselinum, smallage, asparagus, roots of grass, dodder, tamarisk, juncus odoratus, lacca, cupparus, wormwood, chamæpitys, fumaria, scurvy-grass, eringo, nettle, ireos, elder, hyssop, aristolochia, gentian, costus, fennel-root, maidenhair, harts-tongue, daffodilly, asarum, sarsaparilla, sassafras, acorns, abretonum, aloes, agaric, rhubarb infused, onions, garlic, bother, squilla, sow-bread, Indian nard, Celtic nard, bark of laurel-tree, bitter almonds, holy thistle, camomile, gun-powder, sows (millipedes), ammoniac, man's urine, rue, park leaves (vitex), centaury, lupines, chamædrys, costum, ammeas, bistort, camphire, daucus seed, Indian balsam, scordium, sweet cane, galingal, agrimony.

CORDIALS.

Flowers of basil royal, flores caryophillati, flowers of bugloss and borage, rind of citron, orange flowers, rosemary and its flowers, saffron, musk, amber, folium [i. e. nardi folium], balm-gentle, pimpernel, gems, gold,

generous wines, fragrant apples, rose, rosa moschata, cloves, lign-aloes, mace, cinnamon, nutmeg, cardamom, galingal, vinegar, kermes-berry, herba moschata, betony, white sanders, camphire, flowers of heliotrope, penny-royal, scordium, opium corrected, white pepper, nasturtium, white and red bean, castum dulce, dactylus, pine, fig, egg-shell, vinum malvaticum, ginger, kidneys, oysters, crevises (or river crabs), seed of nettle, oil of sweet almonds, sesamium oleum, asparagus, bulbous roots, onions, garlick, eruca, daucus seed, eringo, siler montanus, the smell of musk, cynethi odor, caraway seed, flower of puls, aniseed, pellitory, anointing of the testicles with oil of elder in which pellitory hath been boiled, cloves with goats milk, olibanum.

An extract by the Lord Bacon, for his own use, out of the book of the prolongation of life, together with some new advices in order to health.[1]

1. Once in the week, or at least in the fortnight, to take the water of mithridate distilled, with three parts to one, or strawberry-water to allay it; and some grains of nitre and saffron, in the morning between sleeps.

2. To continue my broth with nitre; but to interchange it every other two days, with the juice of pomegranates expressed, with a little cloves, and rind of citron.

3. To order the taking of the maceration[2] as followeth.

[1] Baconiana, p. 167.

[2] Viz. of rhubarb infused into a draught of white wine and beer, mingled together for the space of half an hour, once in six or seven days. See the Lord Bacon's Life, by Dr. Rawley, towards the end. — *Note by Tenison.*

To add to the maceration six grains of cremor tartari, and as much enula.

To add to the oxymel some infusion of fennel-roots in the vinegar, and four grains of angelica-seed, and juice of lemons, a third part to the vinegar.

To take it not so immediately before supper, and to have the broth specially made with barley, rosemary, thyme, and cresses.

[Sometimes to add to the maceration three grains of tartar, and two of enula, to cut the more heavy and viscous humours; lest rhubarb work only upon the lightest.

To take sometimes the oxymel before it, and sometimes the Spanish honey simple.] [1]

4. To take once in the month at least, and for two days together, a grain and a half of castor in my broth, and breakfast.

5. A cooling clyster to be used once a month, after the working of the maceration is settled.

Take of barley-water, in which the roots of bugloss are boiled, three ounces, with two drams of red sanders, and two ounces of raisins of the sun, and one ounce of dactyles, and an ounce and a half of fat caricks; let it be strained, and add to it an ounce and a half of syrup of violets: let a clyster be made. Let this be taken (with veal) in the aforesaid decoction.

6. To take every morning the fume of lign-aloes, rosemary and bays dried, which I use; but once in a week to add a little tobacco, without otherwise taking it in a pipe.

[1] These two paragraphs are inserted in Blackbourne's edition as part of the paper; but they are not in the *Baconiana*, nor do I know where he got them.

7. To appoint every day an hour *ad affectus intentionales et sanos. Qu. de particulari.*

8. To remember masticatories for the mouth.

9. And orange-flower water to be smelt to or snuffed up.

10. In the third hour after the sun is risen, to take in air from some high and open place, with a ventilation of rosæ moschatæ, and fresh violets; and to stir the earth, with infusion of wine and mint.

11. To use ale with a little enula campana, carduus, germander, sage, angelica-seed, cresses of a middle age, to beget a robust heat.

12. Mithridate thrice a year.

13. A bit of bread dipt in vino odorato, with syrup of dry roses, and a little amber, at going to bed.

14. Never to keep the body in the same posture above half an hour at a time.

15. Four precepts. To break off custom. To shake off spirits ill disposed. To meditate on youth. To do nothing against a man's genius.

16. Syrup of quinces for the mouth of the stomach. Enquire concerning other things useful in that kind.

17. To use once during supper time wine in which gold is quenched.

18. To use anointing in the morning lightly with oil of almonds, with salt and saffron, and a gentle rubbing.

19. Ale of the second infusion of the vine of oak.

20. Methusalem water, of pearls and shells, of crabs, and a little chalk.

21. Ale of raisins, dactyles, potatoes, pistachios, honey, tragacanth, mastic.

22. Wine with swines-flesh or harts-flesh.

23. To drink the first cup at supper hot, and half an hour before supper something hot and aromatised.

24. Chalybeats four times a year.

25. Pilulæ ex tribus, once in two months, but after the mass has been macerated in oil of almonds.

26. Heroic desires.

27. Bathing of the feet once in a month, with lie ex sale nigro, camomile, sweet marjoram, fennel, sage, and a little aqua vitæ.

28. To provide always an apt breakfast.

29. To beat the flesh before roasting of it.

30. Macerations in pickles.

31. Agitation of beer by ropes, or in wheel-barrows.

32. That diet is good which makes lean, and then renews. Consider of the ways to effect it.

MEDICAL RECEIPTS OF THE LORD BACON'S.

The first receipt, or his Lordship's broth and fomentation for the stone.

The broth.

TAKE one dram of eryngium roots, cleansed and sliced; and boil them together with a chicken. In the end, add of elder flowers, and marigold flowers together, one pugil; of angelica seed half a dram, of raisins of the sun stoned, fifteen; of rosemary, thyme, mace, together, a little.

In six ounces of this broth or thereabouts, let there be dissolved of white cremor tartari three grains.

Every third or fourth day, take a small manchet, dipped in oil of sweet almonds ne and sprinkled with a little loaf-sugar.

You may make the broth for two days, an one half every day.

If you find the stone to stir, forbear the course or two.

The intention of this broth is not to void, dermine the quarry of the stones in the ki

The fomentation.

Take of leaves of violets, mallows, pellit wall, together, one handful; of flowers of and mellilot, together, one pugil; the root mallows, one ounce; of anise and fennel seeds one ounce and a half; of flax-seed two dran a decoction in spring water.

The second receipt, shewing the way of makin ointment, which his Lordship called Ungu grans, sive Romanum, the fragrant or R guent.

Take of the fat of a deer half a pound; sweet almonds two ounces: let them be s very gentle fire, and stirred with a stick of they are melted.

Add of root of flower-de-luce powdere roses powdered, together, one dram; of r solved in rose-water half a dram; of clov scruple; of civet four grains; of musk six oil of mace expressed one drop; as much of as sufficeth to keep the unguent from being t

Let all these be put together in a glass, and set upon the embers for the space of an hour, and stirred with a stick of juniper.

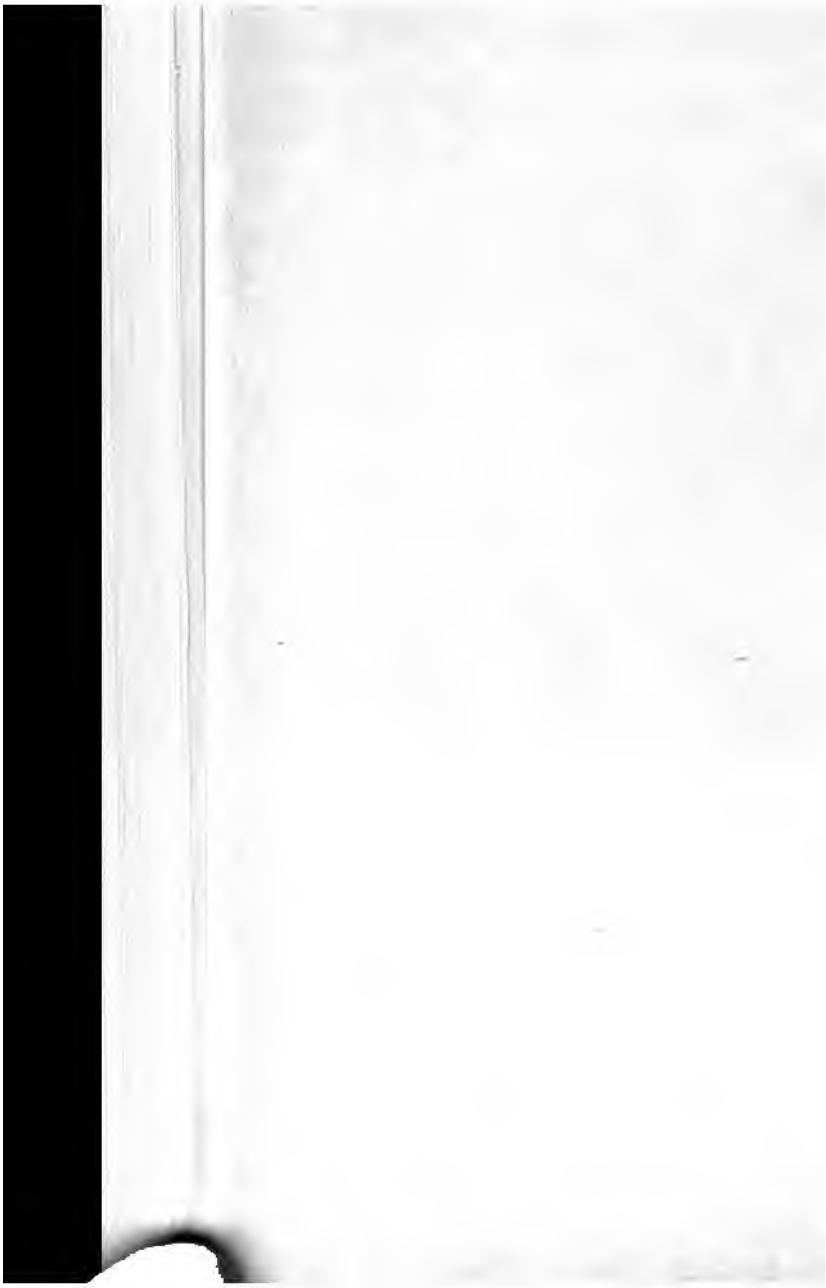
Note, that in the confection of this ointment, there was not used above a quarter of a pound, and a tenth part of a quarter of deer's suet: and that all the ingredients, except the oil of almonds, were doubled when the ointment was half made, because the fat things seemed to be too predominant.

The third receipt. A Manus Christi for the stomach.

Take of the best pearls very finely pulverised, one dram; of sal nitre one scruple; of tartar two scruples; of ginger and galingal together, one ounce and a half; of calamus, root of enula campana, nutmeg, together, one scruple and a half; of amber sixteen grains; of the best musk ten grains; with rose-water and the finest sugar, let there be made a Manus Christi.

The fourth receipt. A secret for the stomach.

Take lignum aloës in gross shavings, steep them in sack, or alicant, changed twice, half an hour at a time, till the bitterness be drawn forth. Then take the shavings forth, and dry them in the shade, and beat them to an excellent powder. Of that powder, with the syrup of citrons, make a small pill, to be taken before supper.

END OF VOL. VII.

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